Journal of the Korean Society of Civil Engineers
Vol. 38, No. 6: 1013-1020/ December, 2018
DOI: https://doi.org/10.12652/Ksce.2018.38.6.1013

ISSN 1015-6348 (Print)
ISSN 2287-934X (Online)
www.kscejournal.or.kr

Water Engineering 수공학

Comparing Water Management Categories of Green Building Rating Systems for Development of Evaluation Criteria of Watersheds

Muhammad Bilal Idrees*, Lee, Jin-Young**, Ahn, Jae-Hyun***, Kim, Tae-Woong****
무하마드 빌랄 이드리스* · 이진영** · 안재현*** · 김태웅****

유역 평가 기준 개발을 위한 그린빌딩 평가 시스템의 물관리 관련 항목 비교 연구

ABSTRACT

With the rapid industrialization and increase in population, more and more people are moving to live in cities. This urbanization trend is resulting in increased construction and development activities which associates with escalation of impervious surface. This in turn causes problems like groundwater depletion, higher flood peaks, and increased rate of soil loss from the watershed. Watershed management projects are being implemented around the globe concerning with the application of soil and water resources conservation practices. It is desirable that an entire watershed be evaluated based on soil and water conservation practices applied. In this study, water management categories of green building rating systems (GBRS) of South Korea, Taiwan, and the Philippines were discussed. The water management practices rating criteria of G-SEED (South Korea), BERDE (Philippines), and EEWH (Taiwan) were explored and compared. The insights of this study are expected to be projected to establish a comprehensive rating system for the evaluation of watersheds. The quantification of watershed management practices will help future planners to identify areas of potential water-related risks and counter the hazards more effectively.

Key words : Watershed management practices, G-SEED, BERDE, EEWH, Rating system

초 록

급속한 산업화와 인구증가에 따라 많은 사람들이 도시에서 살기 위해 이동하고 있다. 이러한 도시화는 건설 및 개발 활동에 따라 도심지내 불투수성 면적을 증가시키며, 이로 인해 지하수위가 낮아지고 유역내 첨두홍수량이 커지며 토양유실이 증가한다. 토양과 수자원을 보전하기 위해서 전세계적으로 유역 관리 사업이 시행되고 있다. 따라서 토양 및 수자원의 보전기술을 활용하여 전체 유역에 대하여 평가하는 것이 바람직하다. 본 연구에서는 한국, 대만 및 필리핀의 녹색건물인증제도(GBRS)의 물관리 관련 항목에 대하여 논의하였다. 또한 G-SEED(한국), BERDE(필리핀), EEWH(대만)의 용수관리 기술의 평가기준을 적용하고 비교하였다. 본 연구의 결과는 포괄적인 유역평가 시스템 개발에 활용될 것으로 기대된다. 정량적인 유역평가기준은 미래의 수자원 관련 잠재적 위험도를 파악하고 보다 효율적이고 효과적으로 대응할 수 있을 것으로 판단된다.

검색어 : 물관리 업무, 녹색건물인증제도, BERDE, EEWH, 등급제도

* 한양대학교 대학원 건설환경공학과 박사과정 (Hanyang University · bilalshah@hanyang.ac.kr)
** 정회원 · 한양대학교 대학원 건설환경공학과 박사수료 (Hanyang University · hydrojy@hanyang.ac.kr)
*** 종신회원·서경대학교 공과대학 토목건축공학과 교수 (Seokyeong University · wrr21@naver.com)
**** 종신회원 · 교신저자 · 한양대학교 공학대학 건설환경공학과 교수, 공학박사 (**Corresponding Author** · Hanyang University · twkim72@hanyang.ac.kr)

Received November 5, 2018/ **revised** November 12, 2018/ **accepted** November 13, 2018

1. Introduction

Urbanization is the process whereby rural populations move to urban areas which enable cities and towns to grow. The industrialization in cities offer better job opportunities causing an increased rate of urbanization because people prefer to live closer to their workplaces. Moreover, urban communities offer the potential of socially, politically, and economically better mileage of lifestyle. The urbanization trend whilst have positive impacts on growth of economies worldwide, it has some negative effects as well. Larger cities are becoming over-populated and problems are arising like poor water and air quality, shortage of potable water, and waste accumulation. Large population require high scale construction for meeting accommodation demands, resulting in permeable land surfaces to be replaced by concrete-built layers (Buckley, 2014).

Construction and development activities corresponds to deforestation and covering of natural ground areas with impervious roads, pathways, and buildings in watershed areas. This in turn create a ripple of problems like groundwater depletion, higher flood peaks, higher velocities of water, and soil erosion. As impervious surfaces do not allow for rainwater to seep down easily, the floodwater volume builds up to form runoff quickly. Runoff travel time on a concrete or asphalt surface like storm drain pipe, street, or road is 50 times greater than on pervious surface (Li et al., 2018). Development activities exacerbate flooding in mainly two ways; a) the volume and velocity of runoff is increased on impervious surfaces so higher flow drifts towards properties downstream, and b) with high urbanization more and more people are living now in flood-prone areas (Ballio et al., 2015).

A watershed is an area of any dimensions in which all flowing water accumulates and drains to a common point of concentration (Singh and Woolhiser, 2002). Managing above mentioned water-related hazards on watershed scale is challenging because watershed systems are complex and involve lots of tightly coupled in-stream processes. Watershed projects are being implemented throughout the world which have pivotal role in managing soil and water resources. The scope of a watershed project may be different depending upon topography and hydrology of the area. In dryland areas such as Pakistan's semi-arid tropical regions, watershed projects are employed to maximize water availability for irrigation and domestic consumption through soil and moisture conservation (Sabatier et al., 2005). In catchments of hydroelectric dams, watershed projects mainly focus on minimizing soil erosion that causes loss of the fertile top layer of soil which deposits in the form of sediments into reservoirs. In densely populated areas, watershed projects are mainly concerned with reducing nonpoint source pollution (Imperial, 2005).

Despite the increasing significance of watershed projects as an approach to natural resource management, relatively little research exists on their impact and evaluation (Weber et al., 2018). However, evaluation is difficult due to the technical and social complexities of phenomenon involved in watershed projects. Historically, watershed project evaluators adopt an approach to derive conclusion from a limited sample of project sites regarding how the same projects would perform in other environments. Evaluations customarily take either qualitative or quantitative methodology and the two approaches generally viewed as alternatives (Sabatier et al., 2005).

As the development of green buildings has increased manifold over the past two decades, a variety of green building rating systems (GBRSs) have been developed recently (Shan and Hwang, 2018). Generally, GBRS is an extensive framework of standards and methodologies developed with the intention of assessing, validating, and verifying the sustainability and degree of greenness of buildings (Nguyen et al., 2016). It includes categories of specific performance thresholds as well as particular guidelines that buildings should meet to be certified as 'green' (Nguyen et al., 2016). GBRS has become increasingly important in the current green building development, as it can authorities in several aspects including baselining, benchmarking, decision-making, and documentation (Eisenstein et al., 2017; Park et al., 2017).

The objective of this study is to provide an insight of rating systems methodologies to trigger the development of a comprehensive rating system for evaluating watershed management projects. To meet this objective, three renowned green building rating systems are studied and compared from water management perspective. Three rating systems studied are Green Standard for Energy and Environmental Design (G-SEED) of South Korea, Ecological, Energy Saving, Waste Reduction, Health (EEWH) of Taiwan, and Building for Ecologically Responsive Design Excellence (BERDE) of Philippines. In section 2, an overview of these rating systems is provided, and their water management categories are discussed. In section 3, the water management categories are compared and their fitting to rate typical aspects of watershed management projects is discussed. The conclusions drawn on the basis of comparative study undertaken are addressed in section 4.

2. Materials and Methods

In the following section, a brief overview of three well-established GBRSs is provided. The rating systems discussed include G-SEED, BERDE, and EEWH. These rating systems are from South Korea, Philippines, and Taiwan respectively which are situated in the same region of the world.

2.1 G-SEED, South Korea

The development of Korean G-SEED (Green Standard for Energy and Environmental Design) started in 2002 with objectives of efficient energy consumption in buildings and the reduction of greenhouse gas (Wang et al., 2014). It is the national GBRS of South Korea. The Korean government introduced critical policies for public building certification with aims of rapid dissemination of green architecture and the introduction of different incentives to induce the private sector's building certification. Already there were different voluntary participation in this certification process in the building industry. Hence, the green building rating system in Korea was successfully developed within a decade owing to strong government policies and participation from the private sector. Korea's successful and rapid implementation of a green building policy and development of consensus on singular GBRS can provide a role model for developing countries planning to introduce green architecture. The different categories of G-SEED along with maximum possible score for each category is given in Table 1. Each category has specified guidelines and set of rules to assign score to a building which reflects degree of adaptation of standards. These categories cover various energy, environmental, and social aspects of structures being used as public household (Jeong et al., 2016; Roh et al., 2016).

Table 1. Categories of G-SEED, South Korea (Wang et al., 2014)

Category	Maximum Possible Score
1. Land use and transportation	16
2. Energy and environmental pollution	20
3. Materials and resources	15
4. Water circulation management	14
5. Maintenance	9
6. Ecological environment	20
7. Indoor environment	21
8. Housing performance sector	0
ID (Innovative Design)	19
TOTAL	134

In this study, the category of 'water circulation management' is explored in further detail. The subcategories of 'water circulation management' are described in Table 2 along with type of assessment they fall in, possible points, and housing types they are employed to. The assessment methods of each sub-category are given in Table 3. All subcategories classify a building in one of the four categories (1st class to 4th class) based on several criteria and evaluations. The 'Rainwater management' subcategory emphasize and rate a building based on amount of 'Low Impact Development' and "Green Infrastructure' techniques adopted in the building. Details about Low Impact development in recent literature can be found in (Wang et al., 2018) and for Green Infrastructure in (Carter et al., 2018).

The 'Rainwater and runoff groundwater usage' is concerned with reduction of water consumption and suppression of storm drainage by using rainwater and runoff groundwater efficiently as alternative water resources. The active use of such alternative water resources can also reduce the energy required for water supply. Subcategory 'Water-saving equipment usage' evaluates a building based on environmental labelled products applied. It emphasized to reduce water and energy consumption by using saving equipment to tackle the increase in water demand due to urbanization and increasing costs of sewage treatment in the cities. The fourth subcategory of 'Water usage monitoring' aims

Table 2. Subcategories of Water Circulation Management (Wang et al., 2014)

Category	Assessment Type	Points	General Housing	Apartment
Rainwater management	optional	5	✔	✔
Rainwater and runoff groundwater usage	optional	4	✔	✔
Water-saving equipment usage	compulsory	3	✔	✔
Water usage monitoring	optional	2	✔	✔

Table 3. Assessment Methods of Subcategories of Water Circulation Management (Wang et al., 2014)

A: Rainwater management		
Class	Facilities to reduce and manage rainwater management capacity	Weighting score
1st class	(LID) method or a green infrastructure (GI) facility that can manage rainwater management area (m^2) x 0.03 (m) or more capacity (m^3) and area of 80 % or more of total impervious surface	1.0
2nd class	(LID) method or a green infrastructure (GI) facility that can manage rainwater management area (m^2) x 0.02 (m) or more capacity (m^3) and area of 80 % or more of total impervious surface	0.8
3rd class	(LID) method or a green infrastructure (GI) facility that can manage rainwater management area (m^2) x 0.01 (m) or more capacity (m^3) and area of 50 % or more of total impervious surface	0.6
4th class	(LID) method or a green infrastructure (GI) facility that can manage rainwater management area (m^2) x 0.001 (m) or more capacity (m^3) and area of 50 % or more of total impervious surface	0.4
B: Rainwater and runoff groundwater usage		
Class	Water tank capacity of rainwater and runoff groundwater (m^3) and direct use installation	Weighting score
1st class	Installation or directly use the water tank of rainwater / runoff groundwater with a construction area (m^2) x 0.03 (m) or more	1.0
2nd class	Establishment of water tank for rainwater and runoff groundwater with construction area (m^2) × 0.02 (m)	0.8
3rd class	Establishment of water tank for rainwater and runoff groundwater with construction area (m^2) × 0.01 (m)	0.6
4th class	Installation or direct use of rainwater / runoff groundwater reservoirs with a building area (m^2) x 0.005 (m) or more	0.4
C: Water saving equipment usage		
Class	Number of points according to total number of environment labelled products applied	Weighting score
1st class	More than 5 points	1.0
2nd class	4 points	0.8
3rd class	3 points	0.6
4th class	2 points	0.4
D: Water usage monitoring		
Class	Water usage monitoring and management	Weighting score
1st class	Level 2 + water consumption meter monitoring and water management program (rainwater utilization facility, heavy water supply facility, etc.)	1.0
2nd class	Level 3 + water consumption meter monitoring and water management program	0.8
3rd class	Level 4 + in-house water-use monitoring devices	0.6
4th class	100% of the water usage measuring meters installed in all households are certified with the environmental label or are in compliance with the standards	0.4

to further reduce water consumption and to support efficient water management.

2.2 EEWH, Taiwan

The EEWH is the GBRS of Taiwan which was developed in 1995 and published in early 2000. It is the first certification system designed for building infrastructures in subtropical regions with high temperature and high humidity. It is also considered the first Asian certification and rating system for green buildings (Chuang et al., 2011). EEWH certification evaluates how green a building is using the following parameters: biodiversity, carbon emissions and construction waste reduction, daily energy conservation, greenery, indoor environment, water conservation, water content of the site, and sewage and waste disposal facility improvement. It is issued at the levels of certified, bronze, silver, gold and diamond. The categories of EEWH, their evaluating factors, and units are presented in Table 4. The 'Water Resource' indicator exists in 'Health' category and its evaluation criteria is given in Table 5 (Chen et al., 2011).

Table 4. Categories of EEWH, Taiwan *

Categories	Indicators	Evaluation factors and units
Ecology	1. Biodiversity	Biotope, green network system
	2. Greenery	CO_2 absorption (CO_2-kg/m^2)
	3. Soil Water Content	water contentment of the site (-)
Energy Saving	4. Energy conservation	ENVLOAD**, Req, PACS***, energy saving techniques
Waste Reduction	5. CO_2 Emission	CO_2 emission of building materials (CO_2-kg/m^2)
	6. Waste Reduction	waste of building demolition (-)
Health	7.I ndoor Environment	Ventilation, daylight, noise control, Eco-material
	8. Water Resource	water usage (L/person), water saving hygienic instrument (-)
	9. Sewer and Garbage	sewer plumbing, sanitary condition for garbage gathering

* (From EEWH official website http://twgbqanda.com/english/index.php).
** Details can be found in (Wang et al., 2018).
*** PACS = Power Application Correction System. For details, see (Fan et al., 2014).

Table 5. Evaluation criteria of 'Water Resource' indicator of EEWH (Chen et al., 2011)

	Usage rate	Weighing factor	Score
Water-saving toilets	a0～a4 = 0~1.0	a0\`～a4\` = -2.0～3.0	a = a0 × a0\`
Water-saving urinals	b0～b2 = 0~1.0	b0\`～b2\` = -1.0～1.0	b = b0 × b0\`
Water-saving taps for public use	c0～c3 = 0~1.0	c0\`~c3\` = -1.0～1.0	c = c0 × c0\`
Water-saving showers	Ratio of bathrooms where tubs are replaced with showers	d1\` = 0.0～1.0	d = d1\` + d2\`
Water-intensive bathtubs	Ratio of bathrooms with personal massage bathtubs or luxury spa showers	d2\` = 0.0～-2.0	
Rainwater/graywater recycling systems, water-saving irrigation systems and other mitigating measures	Presence/absence of water-intensive design/facilities and mitigating measures listed herein	e1\` ～e4\` = -2.0～4	e = Σei\`
WI (Water resource Indicator) total score		= a + b + c + d + e	

2.3 BERDE, Philippines

The BERDE (Building for Ecologically Responsive Design Excellence) Program was established by the Philippines Green Building Council (PHILGBC) to develop market-based tools that can facilitate green building in the property and construction sector. The first version of BERDE for New Construction (BERDE-NC) was released in November 2010 to support local projects aiming for green building certification. To strengthen this program further, the council is establishing the BERDE National Research Agenda on Green Building (BERDE-NRA) which will provide the property industry insight on green building services, technology, knowledge, and methodologies (Ma et al., 2016). The assessment parameters used in BERDE with respective scores of each category are presented in Table 6. Its second category 'Water Efficiency and Conservation' is expanded in Table 7. This category assesses and assign score to a building based on the level a case is reported (Philippines Green Building Council, 2010).

Table 6. Categories of BERDE, Philippines (Philippines Green Building Council, 2010)

Category	Points
Energy Efficiency and Conservation	16
Water Efficiency and Conservation	14
Waste Management	10
Management	4
Use of Land and Ecology	16
Green Materials	8
Transportation	14
Indoor Environment Quality	10
Emissions	8
Total Points	100

Table 7. Water Efficiency and Conservation Criteria in BERDE (Philippines Green Building Council, 2010)

Category	Assessment Method	
WT-01 WATER CONSUMPTION REDUCTION	8	Submitted a water base case report, and policies and procedures for water efficiency and conservation strategies to reduce water consumption by twenty-five percent (25%) or more.
	5	Submitted a water base case report, and policies and procedures for water efficiency and conservation strategies to reduce water consumption by fifteen percent (15%) to less than twenty-five percent (< 25%).
	3	Submitted a water base case report, and policies and procedures for water efficiency and conservation strategies to reduce water consumption by ten percent (10%) to less than fifteen percent (< 15%).
	2	Submitted a water base case report, and policy on the target percentage of the water consumption reduction of the project.
	0	Submitted a water base case report.
WT-02 WATER MONITORING	2	Submitted records on the implementation of the monitoring system, and report on the final assessment.
	1	Submitted records on the implementation of the monitoring system.
WT-03 EFFLUENT QUALITY IMPROVEMENT	4	Submitted the initial assessment report, and the policies and procedures to improve the effluent quality of the project to two (2) classifications higher, or to achieve the highest classification.
	2	Submitted the initial assessment report, and the policies and procedures to improve the effluent quality of the project to one (1) classification higher.
	1	Submitted the initial assessment report, and the policy for the target effluent quality of the project.
	0	Submitted the effluent quality base case report.

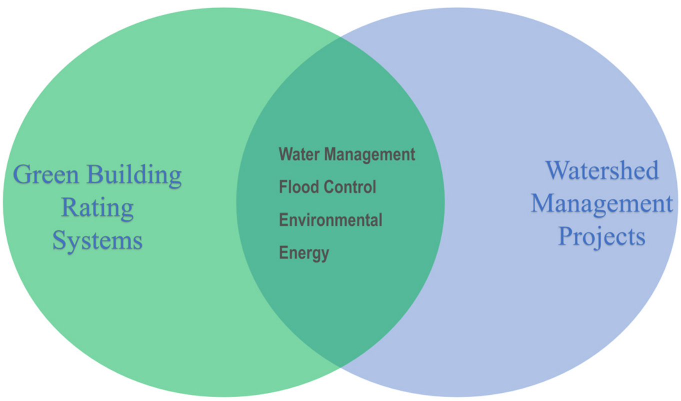

Fig. 1. Categories of GBRSs and Watershed Management Projects

'Water Efficiency and Conservation' category is subdivided into 3 subcategories, i) Water consumption reduction, ii) Water monitoring , and iii) Effluent quality improvement. All these subcategories has their certain assessment methods described in Table 7. A building is assigned a score based on the details of the report submitted to implement water consumption, water usage monitoring, and effluent quality monitoring measures.

3. Application for Watershed Evaluation

The typical components of watershed projects are mainly (1) flood control, (2) potable water availability, (3) pollution control, and (4) soil conservation (Kerr and Chung, 2002). Many methods, techniques, and approaches are adopted to counter these problems with an overall objective to come up with goal of sustainable management of watershed. An ideal comprehensive rating system which can evaluate a watershed project must have mechanisms built into its framework to quantify and rate these categories. The GBRS discussed above are distinguished certification systems to quantify and rate various aspects of a structure. Certain categories of GBRSs and watershed management projects are common (Fig. 1).

The water resource management categories of G-SEED, EEWH, and BERDE are enlisted in Fig. 2. They cover three

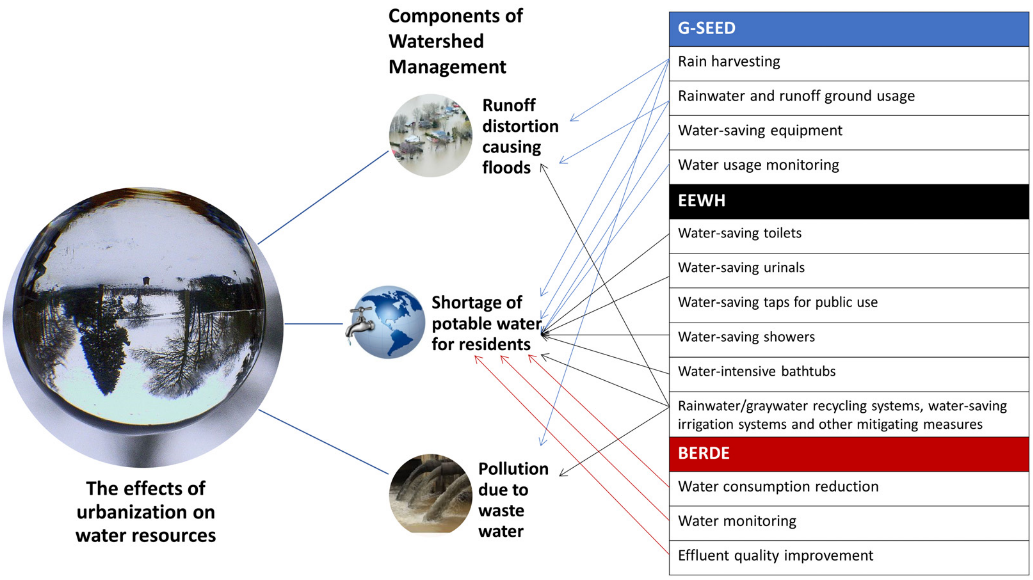

Fig. 2. Water Resource Management Categories of G-SEED, EEWH, and BERDE

components of a watershed project, runoff distortion, potable water availability, and wastewater pollution, as shown in Fig. 2. G-SEED certification methodology is concerned with on-site inspection and calculations to sort a building into one of the four classes. EEWH emphasizes on application of water-saving equipment and graywater recycling because they are vital for hot and humid climate. The BERDE certification system underlines the significance of water usage monitoring and submission of regular reports on water consumption of a building. Following the same lines, a rating system for evaluation of watershed and watershed management projects can be developed.

4. Conclusion

The watershed projects all over the world are applied for soil and water conservation. The watershed management projects lack proper evaluation and a comprehensive rating system is missing. Such a rating system is required which can provide a history on water management practices applied in a watershed, present condition of a watershed, and can suggest future strategies. In this study, three GBRSs from the field of Architecture were selected and studied because of the rich history of Architecture domain in certifications. The water management categories of selected GBRSs were discussed in detail to gain perception of their rating mechanism.

It is concluded that water efficiency and conservation practices quantification is part of three GBRSs. If a comprehensive documentation is developed to integrate the techniques and methodologies of these GBRSs, these can be applied on watershed scale to rate the watersheds by quantifying water management practices applied. This paper is intended to provide technical insight into GBRSs. It is recommended to project the scope of this work to the development of rating system methodology for watersheds. Potential hazards of watershed include flooding, shortage of potable water, pollution, and soil erosion. Quantification of watershed practices by rating system application can reduce these hazards as planners have broader view of spatial and temporal history of applied practices and their deficiencies.

Acknowledgement

This research was supported by a grant [MOIS-DP-2014-02] through the Disaster and Safety Management Institute funded by Ministry of the Interior and Safety of Korean government.

본 논문은 2018 CONVENTION 논문을 수정·보완하여 작성되었습니다.

References

Ballio, F., Molinari, D., Minucci, G., Mazuran, M., Arias Munoz, C., Menoni, S., Atun, F., Ardagna, D., Berni, N. and Pandolfo, C.

(2015). "The RISPOSTA procedure for the collection, storage and analysis of high quality, consistent and reliable damage data in the aftermath of floods." *Journal of Flood Risk Management*, Vol. 11, No. S2, pp. S604-S615.

Buckley, M. (2014). "On the work of urbanization: Migration, construction labor, and the commodity moment." *Annals of the Association of American Geographers*, Taylor & Francis Vol. 104, No. 2, pp. 338-347.

Carter, J. G., Handley, J., Butlin, T. and Gill, S. (2018). "Adapting cities to climate change - exploring the flood risk management role of green infrastructure landscapes." *Journal of Environmental Planning and Management*, Routledge Vol. 61, No. 9, pp. 1535-1552.

Chen, J. N., Lin, H. T. and Ho, M. C. (2011). "The green factory building evaluation system in taiwan: an introduction to EEWH-GF." *Applied Mechanics and Materials*, Trans Tech Publ, pp. 480-483.

Chuang, H. W., Lin, H. T. and Ho, M. C. (2011). "The eco-community evaluation system of Taiwan: An introduction to EEWH-EC." *Applied Mechanics and Materials*, Vol. 71-78, pp. 3466-3469.

Eisenstein, W., Fuertes, G., Kaam, S., Seigel, K., Arens, E. and Mozingo, L. (2017). "Climate co-benefits of green building standards: water, waste and transportation." *Building Research & Information*, Routledge Vol. 45, No. 8, pp. 828-844.

Fan, Y., Kameishi, K., Onishi, S. and Ito, K. (2014). "Field-based study on the energy-saving effects of CO2 demand controlled ventilation in an office with application of energy recovery ventilators:" *Energy and Buildings*, Elsevier, Vol. 68, pp. 412-422.

Imperial, M. T. (2005). "Using collaboration as a governance strategy: Lessons from six watershed management programs." *Administration & Society*, Sage Publications Sage CA: Thousand Oaks, CA, Vol. 37, No. 3, pp. 281-320.

Jeong, J., Hong, T., Ji, C., Kim, J., Lee, M. and Jeong, K. (2016). "Development of an evaluation process for green and non-green buildings focused on energy performance of G-SEED and LEED." *Building and Environment*, Elsevier, Vol. 105, pp. 172-184.

Kerr, J. and Chung, K. (2002). "Evaluating watershed management projects." *Water Policy*, Elsevier, Vol. 3, No. 6, pp. 537-554.

Li, X., Fang, X., Li, J., KC, M., Gong, Y. and Chen, G. (2018). "Estimating time of concentration for overland flow on pervious surfaces by particle tracking method." *Water*, Vol. 10, No. 4.

Ma, Z., Jørgensen, B. N. and Billanes, J. D. (2016). *The Overview of Smart Building Market and Potentials in Philippines*.

Nguyen, T. H., Toroghi, S. H. and Jacobs, F. (2016). "Automated green building rating system for building designs." *Journal of Architectural Engineering*, Vol. 22, No. 4, p. A4015001.

Park, J., Yoon, J. and Kim, K. H. (2017). "Critical review of the material criteria of building sustainability assessment tools." *Sustainability*, Vol. 9, No. 2, pp. 1-24.

Philippines Green Building Council (2010). *BERDE for New Construction Version 1.0 First Edition.*, Philippine Green Building Council.

Roh, S., Tae, S., Suk, S. J., Ford, G. and Shin, S. (2016). "Development of a building life cycle carbon emissions assessment program (BEGAS 2.0) for Korea's green building index certification system." *Renewable and Sustainable Energy Reviews*, Elsevier Vol. 53, pp. 954-965.

Sabatier, P. A., Focht, W., Lubell, M., Trachtenberg, Z., Vedlitz, A., Matlock, M., Kraft, M. E. and Kamieniecki, S. (2005). *Swimming upstream: Collaborative approaches to watershed management*, MIT press.

Shan, M. and Hwang, B. (2018). "Green building rating systems: Global reviews of practices and research efforts." *Sustainable Cities and Society*, Vol. 39, pp. 172-180.

Singh, V. P. and Woolhiser, D. A. (2002). "Mathematical modeling of watershed hydrology." *Journal of Hydrologic Engineering*, Vol. 7, No. 4, pp. 270-292.

Wang, J. J., Kim, J. H., Lee, K. S. and Park, I. S. (2014). "G-SEED: The revised Korean Green Building Certification System." *30th International Plea Conference*, Cept University, Ahmedabad.

Wang, M., Zhang, D. Q., Su, J., Dong, J. W. and Tan, S. K. (2018). "Assessing hydrological effects and performance of low impact development practices based on future scenarios modeling." *Journal of Cleaner Production*, Vol. 179, pp. 12-23.

Weber, L. J., Muste, M., Bradley, A. A., Amado, A. A., Demir, I., Drake, C. W., Krajewski, W. F., Loeser, T. J., Politano, M. S., Shea, B. R. and Thomas, N. W. (2018). "The iowa watersheds project: iowa's prototype for engaging communities and professionals in watershed hazard mitigation." *International Journal of River Basin Management*, Vol. 16, No. 3, pp. 315-328.