Green Campus Study by using 10 UNEP’s Green University Toolkit Criteria in IPB Dramaga Campus

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Abstract. Campus landscape is an important part of campus life, because it is regarded as a physical manifestation of the value of a college. Green campus is a concept to build sustainable living practices that are environmentally friendly in educational institutions around the world, including in IPB Dramaga Campus. The main objective of this study is to identify and analyze IPB Dramaga Campus sustainability using green campus criteria from UNEP (United Nations Environment Programme). The methods stages are data collection, analysis and assessment, and recommendation as the synthesis. All the data analyzed with gap analysis, then it assess with Likert Scale scoring. The results showed that green level of IPB Dramaga Campus is classified as Moderate, with total score 32. The result from each criteria are, Energy, Carbon and Climate Change is Moderate; Water is Not Good; Waste is Moderate; Biodiversity and Ecosystem Services is Very Good; Planning Design & Development is Good; Procurement is Moderate; Green Office is Very Not Good; Green Lab is Moderate; Green IT is Good; and Transport is Good. The Green Level of IPB Dramaga Campus will reach Very Good if these recommendation of strategies applied. The strategies are Green Office, Green Campus Audit, Green Champion, Green Financial Strategies, Water Treatment, Green Lab dan Off Campus Transportation.

1. Introduction
Campus landscape is an important part of campus life, because it is regarded as a physical manifestation of the value of a college. Green campus is a concept to build sustainable living practices that are environmentally friendly in educational institutions around the world including IPB Dramaga Campus. IPB is one of campuses in Indonesia who have started implementing the environmental concept by having IPB Green Campus in 2020 as it vision. There are several references for green campus, two of them are UIGreenmetric and UNEP’s Greening University Toolkit. The first one, UIGreenmetric is a green campus rating which been applied in IPB Dramaga Campus and own six criteria of green campus. The second one, UNEP’s Greening University Toolkit is a green campus toolkit which has not applied before in IPB Dramaga Campus and own ten criteria of green campus. Therefore, this study use UNEP’s green campus criteria to re-examine the green campus implementation in IPB Dramaga Campus as an additional reference in order to actualize IPB Green Campus 2020. The purposes of this study are to identify and analyze green campus implementation in IPB Dramaga Campus, with the final output is a recommendation of green campus strategies that could be applied in IPB Dramaga Campus. This research is expected to be a reference to the relevant parties in designing green campus and to help achieve IPB Green Campus 2020.

2. Methods
This study take place in IPB Dramaga Campus, West Java, or geographically in 6°33’38.3”S 106°43’33.2”E. It started from April 2015 until September 2016. The research consist of several stages, they are

2.1 Preparation and Data Inventories
This study started with desk study for green campus references from article, paper, thesis, or journal. Data inventories for primary data is by interview the key responden, and the secondary data is from literature or direct data from the relevant parties. Data inventories are based upon UNEP’s Greening University Toolkit Criteria.
2.2 Analysis and Assessment
All the data then identified through 10 UNEP’s green campus criteria and analyse using gap analysis by comparing the actual condition and the ideal condition of green campus in IPB Dramaga Campus. The assessment use Likert scoring methods which divided into five level of scoring. Score 1: No Policy, 2: Policy Preparation, 3: Policy in initial implementation, 4: Policy Implemented with some problems, 5: Policy in full implementation. This assessment is consist of several stages from sub criteria, to each criteria, and finally the overall assessment of green campus.

2.3 Synthesis
Final stage is to make a recommendation green campus strategies that could be implemented in IPB Dramaga Campus.

3. Results and Discussions
3.1 General Conditions
IPB Green Campus first announce in early 2015, with UIGreenmetric as it concept based. The purpose of IPB Green Campus are develop the behavior of academicians environmentally friendly, realizing IPB as an environmental campus: zero waste, zero emission, rich in bio-diversity and cultural, creating the conditions campuses that are safe, comfortable and conducive to successful learning systems, as well as to support agro-eco-edu-tourism program. There are several green campus element that are plan to be implemented they are Green Transportatation 2015, Green Movement 2016, Green Energy 2018, Green Building 2019 to finally reach IPB Green Campus 2020.

3.2 IPB Dramaga Campus in UNEP’s Green Campus Criteria
3.2.1 Energy, Carbon and Climate Change
Energy, Carbon and Climate Change is one of the basic issues of sustainability. Although IPB Green Energy is still in it preparation but some of the indicators are already implemented or in its initial stage. The result shows Energy Conservation is Not Good, Energy Efficiency is Moderate, and Renewable and Alternative Energy is Moderate. Overall results for Criteria of Energy, Carbon and Climate Change is Moderate (detail in Table 1).

| Indicators                                           | Score     |
|-----------------------------------------------------|-----------|
| **1. Energy Conservation**                          | Not Good(2) 22 |
| Employment of Energy Manager                        | 5         |
| Energy efficiency standards for new construction and refurbishments | 2         |
| Energy efficiency purchasing standards              | 2         |
| Staff energy conservation training                  | 3         |
| Improved space utilisation to avoid new construction or heating/cooling of underutilised space | 2         |
| Thermal comfort policy (e.g. widening heating/cooling temperature settings) | 2         |
| Financial stragies to assign energy cost incurred - and savings achieved - to the responsible cost centres | 1         |
| Energy / climate change awareness programs          | 4         |
| Establishment of "energy champions" network across campus building | 1         |
| **2. Energy efficiency**                            | Moderate(3) 19 |
| Detailed energy audit to identify pority areas      | 1         |
| Periodic recommissioning and building tuning to optimise energy efficiency | 2         |
| Building retrofitting                                | 4         |
| Lighting                                            | 2         |
| Heating, ventilation and air-conditioning (HVAC)     | 4         |
| Laboratory ventilation and fume hoods               | 4         |
| Installation of building management and control systems (BMCS) and sub-metering for major building energy uses, energy use displays. | 2         |
| **3. Renewable and alternative energy**              | Moderate(3) 16 |
| Purchase of certified “green power”.                | 5         |
| Installation of photovoltaic, wind, biomass, etc. systems. | 3         |
| Installation of cogeneration and trigeneration.      | 1         |
| Fuel switching                                      | 4         |
| University managed revegetation program to offset greenhouse emissions. | 3         |
| **Total Score Criteria of Energy, Carbon and Climate Change** | Moderate(8)  |
3.2.2 Water
IPB Dramaga Campus doesn’t have element for Water, both in UIGreenmetric and this study shows that water practices in this campus is not good. The only good part is they use treatment water for daily consumes, as an alternative of soil water. The result shows Water Conservation is Not Good, Water Efficiency is Moderate, and Water Reuse and Recycling is Not Good. Overall result for Water is Not Good (detail in Table 2).

Tabel 2. Water

| Indicators                                                                 | Score     |
|---------------------------------------------------------------------------|-----------|
| 1. Water conservation                                                     | Not Good (2) |
| Employment of Water Manager (can be combined Energy / Water Manager position). | 5         |
| Water efficiency standards for new construction and refurbishments.        | 2         |
| Water efficiency purchasing standards.                                     | 2         |
| Staff water conservation training (can combine with energy conservation training). | 3         |
| Financial strategies to assign water costs incurred – and savings achieved – to the responsible cost centres. | 1         |
| Water conservation awareness programs – posters, stickers, events and competitions, websites, awards and incentives. | 3         |
| Extension of “energy champions” network to incorporate water conservation. | 1         |
| 2. Water efficiency                                                       | Moderate (3) |
| Detailed water audit and campus water balance to identify priority areas.  | 1         |
| Active maintenance program of early detection and repair of faulty plant, equipment and fixtures. | 4         |
| Retrofitting of water saving devices                                       | 2         |
| Underground pipework leak detection and repair.                           | 4         |
| Use of pervious paving.                                                   | 4         |
| Specification of low water use species for campus grounds.                | 3         |
| Laboratory water use                                                      | 4         |
| Installation of building management and control systems (BMCS) and sub-metering for major building water uses, use displays. | 1         |
| 3. Water reuse and recycling                                              | Not Good (2) |
| Capture and reuse of rainwater from roofs and other hard surfaces for non-potable uses (irrigation, laboratories, toilet flushing, cooling towers, construction works, swimming pools, etc.) | 1         |
| Substitution of borewater for non-potable uses, when combined with managed aquifer recharge to ensure more water is returned to the aquifer than extracted. | 5         |
| Installation of greywater recycling system for treatment of kitchen, laundry and shower water | 1         |
| Composting toilets and urine recovery for fertiliser.                     | 1         |
| Installation of blackwater recycling system to treat sewage for non-potable uses. | 5         |
| Recovery and reuse of fire system test water, vehicle washdown water, etc. | 1         |
| Total Score Criteria of Water                                             | Not Good (7) |

3.2.3 Waste
Waste practices in IPB Dramaga Campus is in its initials stage, and some of the indicators has been fulfilled even has some problems with them. The result shows Policy and Behaviour Change is Moderate, Waste Management is Moderate, and Cloosing the Loop is Moderate. Overall result for Waste Criteria is Moderate (detail in Table 3).

Tabel 3. Waste

| Indicators                                                                 | Score     |
|---------------------------------------------------------------------------|-----------|
| 1. Policy and behaviour change                                            | Moderate (3) |
| Employment of Waste Manager.                                              | 5         |
| Sustainable procurement standards which address longevity, durability, repairability, recyclability and recycled content. | 2         |
| Financial strategies to assign waste costs incurred – and savings achieved – to the responsible cost centres. | 1         |
| Waste management awareness programs                                       | 3         |
| Programs targeting teaching and research to minimise generation of hazardous wastes. | 4         |
| 2. Waste management                                                       | Moderate (3) |
| Waste characterisation study to identify waste stream components and prioritise response. | 3         |
| Individual staged and prioritised programs for waste minimisation which address each component of the university waste stream according to environmental impact. | 2         |
| Performance-based waste management contracts to specify resource recovery targets. | 1         |
| In-house collection of recyclables (e.g. paper / cardboard) where practicable, to support local job creation. | 4         |
| Provision of adequate storage spaces for waste and recyclables.           | 4         |
Secure storage spaces for hazardous wastes to minimise risk of spillage / leakage. 4

3. Closing the loop Moderate (3) 8
Campus based exchange and reuse programs 2
On-site composting of food and garden organics for reuse on campus grounds. 4
Campus based programs to process collected recyclables 2

Total Score Waste Criteria Moderate (9)

3.2.4 Biodiversity and Ecosystem Service
This criteria is the best attained from IPB Dramaga Campus. In April 2016 IPB officially announced as Biodiversity Campus, and no wonder this criteria reach maximum stage. The result shows Policy, Design and Development is Very Good, and Management and Maintenance is also Very Good. Overall result for Biodiversity and Ecosystem Service Criteria is Very Good (detail in Table 4).

Table 4. Biodiversity and Ecosystem Service

| Indicators                                                                 | Score |
|---------------------------------------------------------------------------|-------|
| 1. Policy, design and development                                         |       |
| Survey and evaluation of campus biodiversity and ecosystem services.       | 5     |
| Extension of campus green space (consolidation / intensification of campus buildings over time, installation of green roofs / walls). | 5     |
| Increase density of campus vegetation, e.g. through additional tree planting. | 3     |
| Enhance diversity of campus vegetation.                                   | 3     |
| Green infrastructure / ecological engineering projects (green roofs / walls, designed wetlands for wastewater treatment, phytoremediation of contaminated land, indoor landscapes for biofiltration / indoor environmental quality). | 4     |
| Development of productive landscape systems (permaculture, aquaponics) to provide food / fibre / timber. | 5     |
| Restorative and enabling landscapes for contemplation, recreation and wellbeing. | 5     |
| Campus grounds and green infrastructure used in teaching and research.     | 5     |
| 2. Management and maintenance                                             |       |
| Specify local native species                                              | 5     |
| Preserve significant vegetation during building works                     | 5     |
| Avoid monocultures                                                       | 5     |
| Avoid environmental weeds                                                 | 5     |
| Total Score Biodiversity and Ecosystem Service                            |       |
| Very Good (10)                                                           |       |

3.2.5 Planning, Design and Development
This criteria is in preparation, and planned to be implement in 2019 as IPB Green Building, but some of the indicators is already fulfilled by the current campus building and landscape. The result shows Campus Planning is Very Good, Campus Building Design is Not Good, and Campus Construction Management is Good. Overall result for Planning, Design and Development is Good (detail in Table 5).

Table 5. Planning, Design and Development

| Indicators                                                                 | Score |
|---------------------------------------------------------------------------|-------|
| 1. Campus Planning                                                        |       |
| Campus-specific sustainability objectives included in all campus planning instruments | 5     |
| Space planning at campus, precinct and building scale to optimise flexibility, adaptability, diversity and multifunctionality of spaces. | 5     |
| Investigation of non-building solutions to accommodate university growth.  | 5     |
| Physical accessibility of the campus to the external community, different age groups and people with a disability. | 3     |
| 2. Campus Building Design                                                 |       |
| Design to the appropriate green building rating system as the minimum starting point. | 2     |
| Each new building / major refurbishment to incorporate at least one innovative sustainability feature beyond the requirements of the green building rating system. | 2     |
| 3. Campus Construction Management                                          |       |
| Construction contractors certified to ISO 14001.                          | 5     |
| Contractor staff inducted to the university’s sustainability management system. | 5     |
| Management of campus construction/demolition to minimise on- and off-site impacts. | 2     |
| Total Score Planning, Design and Development                              |       |
| Good (11)                                                                 |       |
3.2.6 Procurement

IPB Dramaga Campus while on its way to IPB Green Campus 2020 is also improving their administration in procurement even if it still in their initial stages. The result shows that Developing Specification is Moderate, Tender Evaluation is Moderate, and Contract Management is Moderate. Overall result of Procurement is Moderate (detail in Table 6).

Table 6. Procurement

| Indicators                          | Score |
|------------------------------------|-------|
| 1. Developing Specification        | Moderate (3) 9 |
| Evaluation of university contracts for procurement of goods and services on the basis of cost, complexity and actual/potential sustainability impacts to determine priorities. | 3 |
| Staged development of sustainable procurement standards / specifications based on identified priorities. | 3 |
| Inclusion of sustainability criteria in tender specifications for procurement of goods and services. | 3 |
| 2. Tender Evaluation               | Moderate (3) 3 |
| Inclusion of sustainability criteria in tender evaluation procedures. | 3 |
| 3. Contract Management             | Moderate (3) 6 |
| Inclusion of sustainability objectives and targets in contract management documentation, and regular monitoring of progress. “Second party” audits of providers to drive continual improvement through the supply chain. | 3 |
| Total Score Procurement            | Moderate (9) |

3.2.7 Green Office

IPB Dramaga Campus is also doesn’t have element to manage the Green Office, therefore this criteria result is the worst. The result shows Policy and Behaviour Change is Very Not Good, and Office Practices is also Very Not Good. Overall result for Green Office is Very Not Good (detail in Table 7).

Table 7. Green Office

| Indicators                          | Score |
|------------------------------------|-------|
| 1. Policy and behaviour change     | Very Not Good (1) 6 |
| Employment of Green Office Manager. | 1 |
| Sustainable procurement standards for office equipment and consumables. | 1 |
| Education, training and awareness programs | 3 |
| Establishment of “Green Office champions” network across campus buildings as the vehicle for the energy and water conservation network | 1 |
| 2. Office Practices                | Very Not Good (1) 2 |
| Campus wide audit of office practices disaggregated to department level | 1 |
| Establishment of department-specific prioritised targets to drive continual improvement | 1 |
| Total Score Green Office           | Very Not Good (2) |

3.2.8 Green Lab

Green Lab practice is also doesn’t applied in IPB Green Campus policy, but some of the indicators fulfilled by standard lab of IPB Campus. The result shows Policy and Behaviour Change is Very Not Good, Laboratory Practice is Not Good, and Maintenance and Capital Works is Moderate. Overall result for Green Lab is Not Good (detail in Table 8).

Table 8. Green Lab

| Indicators                          | Score |
|------------------------------------|-------|
| 1. Policy and behaviour change     | Very Not Good (1) 7 |
| Employment of a Green Lab manager. | 1 |
| Development of a “green chemistry” program. | 1 |
| Sustainable procurement standards for lab equipment and consumables. | 4 |
| Green Lab online and face-to-face training. | 1 |
| 2. Laboratory Practices            | Not Good (2) 10 |
| Campus wide audit of university laboratories – energy, water, input and output of chemicals, hazardous waste management. | 1 |
| Establishment of lab-specific prioritised targets for improvement. | 5 |
| Development of online tracking system for chemical management (inputs, processes and outputs). | 3 |
| Establish lab equipment / consumables exchange program to minimise waste. | 1 |
| Maintenance and capital works      | Moderate (3) 13 |
Development of green laboratory design standards, e.g., referencing Labs21. 
Laboratory ventilation and fume hoods 
Laboratory water use 
Secure storage spaces for hazardous wastes to minimise risk of spillage / leakage.

| Total Score Green Lab | Not Good (6) |

3.2.9 Green IT

Even if, Green IT is not applied in one of IPB Green Campus element but some of the indicators fulfilled by the IT standards of IPB Campus. The result shows IT Policy and behaviour change is Moderate, and IT Management and Capital Works is Good. Overall result for Green IT is Good (detail in Table 9).

| Table 9. Green IT |
|-------------------|
| **Indicators**    | **Score** |
| 1. IT Policy and behaviour change | Moderate (3) |
| Adoption and implementation of IT purchasing standards (e.g. IEEE, EPEAT, etc.). | 5 |
| “Switch off when not in use” awareness programs | 3 |
| Standard operating environments (hardware and software). | 1 |
| 2. IT Management and Capital Works | Good (4) |
| Reduce frequency of computer replacement programs – substitute software upgrades for hardware upgrades where possible. | 5 |
| Centralised / dedicated server space(s) to avoid dispersing server heat loads across multiple buildings. | 5 |
| Computer reuse program, e.g. donation to community groups / schools. | 2 |
| E-waste program. | 4 |
| Ensure energy saving features are enabled. | 1 |
| **Total Score Green IT** | Good (7) |

3.2.10 Transport

Transport is the first green campus practices that been applied in IPB Dramaga Campus. Most of the indicators is already done but not at its maximum effort because of some problems like it’s not acceptable yet in IPB Dramaga Campus environment. The result shows Transport in General is Very Good, Commuter Transport is Moderate, and Travel on University Business is Good. Overall result for Transport is Good (detail in Table 10).

| Table 10. Transport |
|---------------------|
| **Indicators**      | **Score** |
| 1. General | Very Good (5) |
| Employment of Transport Manager. | 5 |
| Development of university transport policy. | 4 |
| 2. Commuter Transport | Moderate (3) |
| Student housing and services on or close to campus. | 5 |
| Awareness and promotion of alternatives to private transport – posters, stickers, events and competitions, websites, awards and incentives. | 3 |
| Regular liaison with public transport providers to optimise services to the campus. | 1 |
| Incentives for staff committing to forego use of private commuter transport. | 1 |
| Secure, undercover bike racks, and shower facilities, lockers and bike repair workshop for cyclists. | 4 |
| Car pooling programs. | 4 |
| Reduction of car parking spaces and provision of dedicated spaces for car pool vehicles and electric vehicles (and also charging points). | 4 |
| Establishment of shuttle bus service where the university has multiple campuses. | 5 |
| Acknowledgement that for reasons of social equity, disability, etc. some staff and students will still need to use private vehicles to access the campus. | 1 |
| Pedestrian-friendly campus to minimise internal motor vehicle trips. | 4 |
| 3. Travel on University Business | Good (4) |
| Acquisition and promotion of video conferencing technology to staff and students. | 3 |
| University managed revegetation program to offset emissions for air travel, and/or commitment to “third party” carbon credit / carbon offset program. | 1 |
| Purchase of fuel efficient vehicles for university fleet. | 3 |
| Regular maintenance to optimise motor vehicle fleet fuel efficiency. | 5 |
| **Total Score Transport** | Good (12) |
3.3 Green Level of IPB Dramaga Campus
The result shows that green level of IPB Dramaga Campus is Moderate with total score 31 (Table 11).

| No | Criteria                                                   | Score | Nilai          |
|----|------------------------------------------------------------|-------|----------------|
| 1  | Energy, Carbon, and Climate Change                        | 3     | Moderate       |
| 2  | Water                                                      | 2     | Not Good       |
| 3  | Waste                                                      | 3     | Moderate       |
| 4  | Biodiversity and Ecosystem Service                        | 5     | Very Good      |
| 5  | Planning, Design and Development                          | 4     | Good           |
| 6  | Procurement                                                | 3     | Moderate       |
| 7  | Green Office                                               | 1     | Very Not Good  |
| 8  | Green Lab                                                  | 2     | Not Good       |
| 9  | Green IT                                                   | 4     | Good           |
| 10 | Transport                                                  | 4     | Good           |
|    | **Total**                                                  | **31**| **Moderate**   |

*Score (1 = Very Not Good; 2 = Not Good; 3 = Moderate; 4 = Good; 5 = Very Good)

| Total Score (10 – 17 = Very Not Good; 18 – 25 = Not Good; 26 – 33 = Moderate; 34 – 41 = Good; 42 – 50 = Very Good) |

3.4 Recommendation Green Campus Strategies for IPB Dramaga Campus
Based on the results of the analysis, some of strategies that need to be added to IPB Green Campus are the Green Office, Green Campus Audit, Green Champion, Green Financial Strategies, Water Treatment, Green Lab and Off Campus Transportation. All policies could be made simultaneously, but the implementation can be done gradually in order to be sustainable, particularly for Green Office, Green Campus Audit, Green Champion, and Green Financial Strategies and Green Financial Strategies, whose policies are closely interconnected. Green Office, Green Campus Audit, Green Champion, Green Financial Strategies and Green Lab will be based upon the indicators of UNEP’s Greening University Toolkit. Meanwhile the Water Treatment strategies will be implemented as Waste Water Garden to treat greywater waste from IPB Dramaga Campus. Off-Campus Transportation is an additional strategies to IPB Dramaga Campus so they should not only concern about in-campus matter but also surround the campus. If those strategies applied in IPB Dramaga Campus, the green level will increase from Moderate to Good or even Very Good depended of the implementation itself.

4. Conclusion
The study results that IPB Dramaga Campus green level through 10 UNEP’s Green Campus is Moderate with total score 31. That green level will be increase from Moderate to Very Good with a proper implementation of Green Office, Green Campus Audit, Green Champion, Green Financial Strategies, Water Treatment, Green Lab and Off Campus Transportation.

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