

# Framework Development of Campus Sustainability Assessment. Case Study: Diponegoro University

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**Abstract.** Campus sustainability has been the focus of global issues by university planners and policy makers as a result of realizing the impact of university activities on the environment. Application of campus sustainability in Indonesia, especially Diponegoro University (UNDIP) is still not widely done. There are several phenomena in UNDIP towards campus sustainability. This study discusses the assessment of campus sustainability in UNDIP. The framework to be used is a framework developed by Alghamdi in 2017. The AHP method will be used in determining the priorities of the main criterias, sub criterias, and indicators of the framework. The output of the priority will be used to calculate the sustainability score in UNDIP by multiplying the weight and scale of each indicator. The research has shown that there are 5 main criterias, 14 sub criterias, and 35 indicators. The important priorities are management with weight of 0.462, academia with weight of 0.172; environment with weight of 0.169; engagement with weight of 0.127; and innovation with weight of 0.070. The result of campus sustainability score in UNDIP is 75,1050 indicating that UNDIP is very sustainable.

Keywords: **campus sustainability, AHP, Delphi, score**

## 1 Introduction

In the second decade of the 21<sup>st</sup> century, the number of colleges that increased its sustainability activities increased [1]. Sustainability has the meaning of being capable of being sustained or the ability to remain sustainable. One of the latest developments in the application of sustainability is the campus sustainability that has become the focus of global issues by university planners and policy makers as a result of the realization of the impact of university activities on the environment [2].

The application of campus sustainability in Indonesia, especially Diponegoro University (UNDIP) is still not widely done. The results of the formulation of UNDIP campus policy strategy in the implementation of campus sustainability by using framework developed by Alshuwaikhat and Abubakar in 2008 indicate that UNDIP needs alternative framework towards the campus sustainability such as GASU, ISO 14001, EMAS, and STARS so that can complement the strategy formulated each other [3]. To reach the campus sustainability, the actions and policies are required according to the framework developed by the researchers.

Based on the UI Green Metric World University Ranking, UNDIP successfully ranked as the 3<sup>rd</sup> best green campus in Indonesia in 2015 and the ranking declined in the following years, to the last, UNDIP was ranked 6<sup>th</sup> as the greenest university in Indonesia in 2017 [4]. Based on the preliminary study that has been done in UNDIP environment, there are some phenomenons

towards campus sustainability, namely (1) Maintenance of green open space and campus forest is still lacking [5]; (2) High electricity consumption, which requires more funds for office activities and does not save energy consumption. Use of daylight lighting in more than 75% of buildings, such as the Faculty of Economics and

Business and Faculty of Engineering [5]; (3) In 2015, waste production reaches 4,703 m<sup>3</sup> or equivalent to 6786 trunks wheel. The waste segregation at Integrated Waste Treatment Plant of UNDIP only focuses on the segregation of economic value of garbage such as plastic bottle waste and cardboard paper waste [6]. (4) Low quality of clean water, cloudy water, and sometimes unpleasant smell [5]; (5) 62% of students choose to use motorcycles rather than public transportation with the main reason for the inconvenience of public transport service [7] thus increasing air pollution and causing congestion at certain hours; (6) The big number of vehicle student, which is dominated by cars, to the road that causes side barriers due to lack of parking space as happened at the Faculty of Humanities, Faculty of Law, Faculty of Social Science and Political Science, Faculty of Engineering [8]; (7) The use of air conditioning (AC) throughout the campus building, including new buildings [8].

Therefore, there should be the implementation of campus sustainability in UNDIP to create a sustainable campus by looking at five main criterias of campus sustainability assessment: management, academia, environment, engagement, and innovation and determining the best policy alternative in applying campus sustainability by using Analytic Hierarchy

Process (AHP). The compiled framework is used to calculate the campus sustainability score to identify the sustainability conditions in UNDIP. Sustainability score is a weighted score that is by multiplying the weight of each assessment indicator with rating scale. This study refers to the research of Alghamdi & Jonge (2017). In addition, field studies are also conducted to determine the suitability of reference models with the conditions in the field. If there are sub criterias and indicators that have not been listed on the reference model then it can be added in the research. The main criterias, sub criterias, and assessment indicators are then clarified in accordance with their respective hierarchies using the Delphi method to summarize the expert opinion information involved. Then the weighted of each main criteria and sub criteria processed using Analytic Hierarchy Process (AHP) method. The method gives more accurate results and will compare the main criterias, sub criterias, and framework indicators developed by Alghamdi & Jonge in 2017. The results of the method are the priority to the main criterias, sub criterias, and framework indicators so that it will produce the strategies towards campus sustainability. After that, an assessment of UNDIP was done to determine the sustainability condition and then calculated the campus sustainability index by multiplying the weight of each scoring indicator and scale.

The object of this research is UNDIP. UNDIP selected due to the implementation of campus sustainability in UNDIP still need attention. The phenomenon in the field shows the need for attention to the management of the campus environment in the direction of sustainability so that the need for priority action in the direction of the campus.

## 2 Research methods

The Delphi method is a method that involves several experts in the decision-making process. These experts are not met face-to-face and the identity of each expert is hidden so that each expert does not know the identity of other experts in order to avoid the dominance of other experts and can minimize biased opinions.

AHP is a measurement theory with pairwise comparisons and depends on expert judgment in obtaining priority scale [9]. AHP is used to make effective decisions on complex issues or issues of Multiple Criteria Decisions Making (MCDM). This decision support model describes the complex multi-criteria or multi-factor problem into a hierarchy. The first level is the goal followed by the level of factors, criterias, sub criterias, and so on down to the last level of the alternative. This process relies on knowledge, experience, and imagination in constructing a hierarchy of problems and relying on experience and logic in giving consideration [10].

The following is the calculation step of campus sustainability assessment score:

1. Calculation of the score value for each of the main criteria using the equation.

2. Calculation of campus sustainability assessment score using the equation:

$$ICS = MAN + ACA + ENV + ENG + INN \quad (1)$$

3. Determination of the category of campus sustainability assessment. The following categories of campus sustainability [11]:

**Table 1** Score Category and Status of Sustainability

Score	Category
0,00-25,00	Bad (no sustainability)
25.01-50.00	Less (less sustainability)
50.01-75,00	Enough (enough sustainability)
75,01-100,00	Good (very sustainable)

## 3 Case study: result and discussion

The calculation result shows that the value of campus sustainability score in UNDIP is 75,10502546. Based on the score categorization and sustainability status, the sustainability status is in a very sustainable category.

The assessment method of campus sustainability in UNDIP in this study has advantages:

1. Simple assessment method.
2. The assessment method is easy to understand and use.
3. The assessment method has reached the assessment stage so that it can know the grade of a university.
4. The method uses quantified data, not just using a qualitative scale.

The disadvantages of campus sustainability assessment method in UNDIP are:

1. Weight is built based on the perception of expert respondents so that the assessment results are less objective and accurate.
2. Need for further validation and verification because the assessment is subjective.

To improve or maintain the campus sustainability assessment score in UNDIP, what needs to be done is to improve the indicator that has the lowest score among all indicators. The indicator that has the lowest score is inorganic waste treatment. The following is an upgrading recommendation of campus sustainability in UNDIP:

- Establishment of a garbage collection management organization consisting of special management officers (managers of each department and TPST manager) responsible for collection and maintenance of waste infrastructure facilities.
- Equalization of tasks by creating inorganic waste recycling section structures, socialization section, monitoring, and evaluation, and product marketing section.
- Procurement of garbage collection vehicles and tools that can process waste such as incinerator (inorganic waste burners that have no selling value).
- Schedule inorganic waste collection time.
- Waste collection in each department by providing a separate bin between organic and inorganic waste.
- Organize sorting of organic and inorganic waste in order to facilitate in further processing process.

- Reduce (waste reduction activity):
  - Use durable materials or items.
  - Reduce the use of disposable goods.
  - Maintain and repair tools and equipment instead of replacing them with the new ones.
- Reuse:
  - Reusing packaging for the same function or other functions.
- Utilize packaged goods into storage places.
- Using reusable materials rather than once discarded.
- Recycle:
  - Inorganic waste that still has economic value that can be recycled (for example: paper, plastic, glass, can, bottle, the rest of cloth), packing then sold to garbage collector or recycled by making craft from garbage.

**Table 2** Calculation Result of Campus Sustainability Score

Criteria	Sub Criteria	Indicators	Indicators Weight	Respondent Score Averages	Score
Management	Commitment	The visibility of sustainability concern & commitment on the campus through environmental days	0,11682132	70	8,1774924
		Institutions committed to sustainability provide students with specific opportunities & settings	0,10031868	78,125	7,837396875
	Strategies	Raising awareness & securing the participation of the institution's staff & students in SD	0,034306272	75,3125	2,58369111
		Collaboration between faculties, institutions & stakeholders	0,020671728	80,3125	1,660198155
	Leadership	A body responsible for sustainability in the institution	0,18942	79,375	15,0352125
Academia	Formal and informal education	Sustainability courses/total courses	0,106984	80	8,55872
	Research & Development	Sustainability research funding/total research funding	0,019309752	82,5	1,59305454
		Sustainability publication	0,013068216	82,5	1,07812782
		Sustainability events	0,014693616	78,125	1,14793875
		Sustainability website	0,008582112	76,25	0,65438604
Sustainability organization (student)	0,00942732	70	0,6599124		
Environment	Energy and climate change	Energy efficient appliances usage	0,007267	73,125	0,531399375
		Energy conservation program	0,003604432	65,625	0,23654085
		Climate change adaptation and mitigation program	0,003648034	74,0625	0,270182518
	Green Campus	Green building	0,010036572	65,3125	0,655513609
		Green transportation	0,008396934	56,875	0,477575621
		Campus preservation	0,016495752	79,0625	1,304195393
		Biodiversity	0,007751016	80	0,62008128
		Sustainability budget/total university budget	0,007005726	70,625	0,494779399
	Waste	Recycling program for university waste	0,005737212	75,625	0,433876658
		Hazardous and toxic waste treatment	0,005016596	61,875	0,310401878
		Non-hazardous and non-toxic waste treatment	0,003769376	76,25	0,28741492
		Organic waste treatment	0,003104192	78,125	0,242515
		Inorganic waste treatment	0,00291018	73,75	0,214625775
		Policy to reduce the use of paper and plastic on campus	0,007178444	75,625	0,542869828
	Water	Waste water treatment	0,0278005	65	1,8070325
		Piped water	0,0119145	80,625	0,960606563
	Transportation	Total cars entering/total people	0,024167	63,125	1,525541875
Public space	Public space	0,013182	80	1,05456	
Engagement	Engagement with the public	Alumni participation	0,011745468	78,125	0,917614688
		Continuing education	0,021579967	71,875	1,551060128
		Community stakeholders engagement	0,013283565	72,5	0,963058463
	Engagement within the campus community	Campus community engagement	0,029017341	71,25	2,067485546
		Empowerment	0,031561659	70	2,20931613
	Outreach	Engaging into community service, service learning & or internship programs	0,019685	69,375	1,365646875
Innovation			0,07	72,5	5,075
Total					75,10502546

- Resell inorganic waste that can be sold, such as plastic bottles, clear glass, cardboard, clean paper, and crackle to Bank Trash.
- Briefing to university citizens to sort waste by type when disposing of garbage.
- Providing incentives to departments and university citizens who can encourage to carry out proper and correct waste segregation activities. Incentives can be a reward.
- Provision of disincentives in the form of reprimands, sanctions, or mulct to departments or university citizens who have not conducted proper waste sorting activities.
- Cooperation between university managers, government and institutions or organizations such as Trash Bank related to socialization, dissemination of disincentive incentives, good and proper waste reduction and handling (sorting, packing, reusing) activities.
- Training skills from waste materials by bringing the experts in order to manage inorganic waste of economic value and do sales of inorganic waste recycling products.

## 4 Conclusion

There are five main criterias for the assessment of campus sustainability, namely management, academia, environment, engagement, and innovation. There are three sub criterias in the main criteria of management, namely commitment, strategies, and leadership; the main criteria of academia are described as sub criteria of formal and informal education and research & development, the main criteria of the environment are described as sub criteria of energy and climate change, green campus, waste, water, transportation, and public space, the main criteria of engagement are described as sub criteria engagement with the public, engagement within the campus community, and outreach, and the main criteria of innovation are not described as sub criteria. Sub criteria commitment consist of two indicators, namely the visibility of sustainability concern & commitment on the campus through environmental days and the institutions dedicated to sustainability provide students with specific opportunities & settings. The sub criteria strategy consists of two indicators: raising awareness & securing the participation of the institution's staff and students in SD and collaboration between faculties, institutions & stakeholders. The sub criteria of research & development consist of five indicators, namely sustainability research funding/total research funding, sustainability publication, sustainability events, sustainability website, and sustainability organization (student). Sub

criteria of energy and climate change consist of three indicators, namely energy efficient appliances usage, energy conservation program, and climate change adaptation and mitigation program. Green campus sub criteria consist of five indicators, namely green building, green transportation, campus preservation, biodiversity, and sustainability budget/total university budget. The waste sub criteria consist of six indicators, namely recycling program for university waste, non-hazardous and toxic waste treatment, organic waste treatment, inorganic waste treatment, and policy to reduce the use of paper and plastic on campus. Sub criteria water consists of two indicators, namely waste water treatment and piped water. Sub criteria engagement with the public consists of three indicators, namely alumni participation, continuing education, and community stakeholders' engagement. Sub criteria engagement within the campus community consists of two indicators, namely campus community engagement and empowerment.

The developed model can be used by UNDIP by multiplying the indicator weight and scale of each indicator based on the categorization of each indicator in the table of indicators of the campus sustainability assessment to obtain the campus sustainability score used to determine the sustainability condition. The result of sustainability score calculation shows that the value of campus sustainability score in UNDIP is 75.10502546. Based on the score categorization and sustainability status, the sustainability status is in a very sustainable category.

The suggestions are based on the results of research is Using alternative methods that can be used to perform the weighting process against the main criterias, sub criterias, and indicators framework campus sustainability, such as Analytical Network Process in order to know the relationship between indicators in addition to compare the results of weighting and evaluation of weighted results. In addition, using alternative framework in the direction of the campus sustainability such as GASU, ISO 14001, STARS, and EMAS, so it can complement the strategy formulated.

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