

Development of weighting value for ecodrainage implementation assessment criteria

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Abstract. This research aim to generate weighting value for each factor and find out the most influential factor for identify implementation of ecodrain concept using loading factor and Cronbach Alpha. The drainage problem especially in urban areas are getting more complex and need to be handled as soon as possible. Flood and drought problem can't be solved by the conventional paradigm of drainage (to drain runoff flow as faster as possible to the nearest drainage area). The new paradigm of drainage that based on environmental approach called "ecodrain" can solve both of flood and drought problems. For getting the optimal result, ecodrain should be applied in smallest scale (domestic scale), until the biggest scale (city areas). It is necessary to identify drainage condition based on environmental approach. This research implement ecodrain concept by a guidelines that consist of parameters and assessment criteria. It was generating the 2 variables, 7 indicators and 63 key factors from previous research and related regulations. the conclusion of the research is the most influential indicator on technical management variable is storage system, while on non-technical management variable is government role.

Keywords: criteria, cronbach alpha, ecodrain, loading factor, sustainable

1. Introduction

Sustainable development is a concept that emphasizes the conservation and preservation of natural resources. It is comprehensive and is therefore not limited to certain activities, and it is closely related to the continuation of human life on earth. Sustainable development concerns three primary categories: economic, social, and environmental. These three elements are interconnected to create security, harmony, and prosperity. Sustainable development seeks to balance human needs and demands with the environment's capacity to cope with human consumption and industry [1]. For assuring local sustainability in the form of shaping sustainable human settlements an appropriate sustainable management on a local level is necessary to be carried out. In the process of operationalization of sustainable development an important part is represented by developing innovative models for sustainable land management [2].

Water is the source of life, and anyone can't survive without water. Urban drainage presents a classic set of modern environmental challenges: the need for cost-effective and socially acceptable technical improvements in existing systems, the need for assessment of the impact of those systems, and the need to search for sustainable solutions. There are numerous techniques and approaches known around the world how to support sustainable rainwater management, especially in the urban areas, where the storm water can cause significant damages [3].



In urban areas, the drainage problem consist of flood, drought and water pollution are getting more complex and need to be handled as soon as possible. Flood caused by incapability of river in collecting actual water discharge (river overflow) while inundation occurs when runoff and local inflow cannot be drained into the nearest drainage channel or river. Drought caused by the decreasing of groundwater level and water supply especially in the dry season. There are 2 method of drainage on water resources engineering, the conventional method adopt “hard engineering principle” and the recent one known as “ecodrain”. The principle of conventional method is to drain runoff flow as faster as possible to the nearest drainage area while the principle of Ecodrain is increase water infiltration and storage to decrease runoff discharge. The conventional drainage design approach does not address sustainability issues. Moving forward, an ecodrain approach using green infrastructures is recommended. In addition to flow and flood management provided by the conventional methods, green infrastructures can bring multiple benefits such as increased amenity value and groundwater recharge. The main advantage of the sustainable approach is the additional benefits such as environmental improvement, natural groundwater recharge, runoff reduction as well as energy savings [4].

For the optimal result, ecodrain should be applied in smallest scale (domestic scale) to the biggest scale (city areas). Ecodrain can be implemented if the drainage infrastructure meets the criteria and indicators. Therefore, it is necessary to identify drainage condition based on environmental approach. For identify the implementation of ecodrain concept, it use a guidelines that consist of ecodrain criteria and indicators. According to researchers [5], [6], there are 2 variables, 7 indicators and 63 key factors for identify the implementation of ecodrain concept, consist of: technical and nontechnical management as variables, technical management consist of infiltration system, drainage system, complementary building system, storage system, and pump system as indicators, while non-technical management consist of government role and community participation as indicators. From those indicators, 63 key factors was generated (type and channel dimension, water quality, sediment transport, monitoring evaluation existence, etc [5], [6].

Based on researcher [7] and Indonesia’s related regulation, there are several factors that influenced implementation of ecodrain concepts, such as:

- Separation between drainage and waste water network for urban areas.
- Masterplan with area more than 10 hectare should be built retention ponds, rainwater subreservoir and absorption wells
- Groundwater recharge, rainwater reuse and recycle and low impact development concept.
- River has function as natural drainage channel.
- Development area plan should have at least 30% of total area which used as retention areas
- etc

For non technical management variables, researcher [8] was mentioned that public perception toward cultural attraction will give the tremendous boost to any development. The groups identified as the most influence and affected individual are the local authorities, local communities, and the tourists [8]. Therefore, government role and community participation is used as non technical management variables. This research aim to develop the weighting value for 2 variables (technical and non technical), 7 indicators and 63 key factors using SPSS. From this research, the most influenced indicator and factor can be determined. Further, the most influenced factor should be prioritized by government and community to implement ecodrain concept.

2. Research Method

Methods used in this research are:

- a) Developing factors validity and indicators reliability using SPSS. The validity of all factors has been tested by determining loading factor meanwhile the reliability of all indicators has been tested by using Cronbach alpha. All factors and indicators are valid if the value of loading factor and Cronbach alpha close to 1.
- b) Developing weighting value for all factors and indicators from percentage of the loading factors and Cronbach alpha value. From the weighting value, it can be conclude the most influential factor and indicator to identify the implementation of ecodrain concept in an area.

3. Results and Discussion

The result of this research consist of:

- a) All indicators (Infiltration system, drainage channel system, complementary system building, storage system, pump system, government role and community participation) from 2 variable (technical and non technical) meets the reliability requirement with Cronbach Alpha value 0.732-0.838
- b) All key factors from 7 indicators fulfil the validity test with loading factor value 0.428-0.748.

The recapitulation of evaluation results on validity and reliability evaluation can be seen in Table 1.

Table 1. Validity and reliability test for indicator and factor of evaluation.

Indicator	Code	Validity Loading Factors	Reliability Cronbach Alpha	Description	Weighting Value
<i>Infiltration System (A1)</i>	A1		0.732	<i>Reliable</i>	13.19
Type of infiltration system selection	A11	0.553		Valid	1.55
Determination of infiltration system number and capacity	A12	0.561		Valid	1.57
Determination of infiltration system location	A13	0.534		Valid	1.5
Waste management in infiltration system	A14	0.617		Valid	1.73
Water quality management in infiltration system	A15	0.597		Valid	1.67
Sediment management in infiltration system	A16	0.683		Valid	1.91
Vegetation management in infiltration system	A17	0.695		Valid	1.95
The existence of monitoring evaluation system	A18	0.468		Valid	1.31
<i>Drainage Channel Systems (A2)</i>	A2		0.747	<i>Reliable</i>	13.46
Type of drainage channel selection	A21	0.524		Valid	1.46
Determination of drainage channel dimension and capacity	A22	0.688		Valid	1.92
Determination of drainage channel location	A23	0.638		Valid	1.78
Waste management in drainage channel system	A24	0.535		Valid	1.49
Water quality management in drainage channel system	A25	0.532		Valid	1.48
Sediment management in drainage channel system	A26	0.665		Valid	1.85
Vegetation management in drainage channel system	A27	0.678		Valid	1.89
The existence of monitoring evaluation system	A28	0.571		Valid	1.59
<i>Complementary System Building (A3)</i>	A3		0.789	<i>Reliable</i>	14.21
Type of complementary system building selection	A31	0.517		Valid	1.45
Determination of complementary system building dimension and capacity	A32	0.711		Valid	1.99
Determination of complementary system building location	A33	0.688		Valid	1.93
Waste management in complementary system building	A34	0.582		Valid	1.63

Indicator	Code	Validity Loading Factors	Reliability Cronbach Alpha	Description	Weighting Value
Water quality management in complementary system building	A35	0.63		Valid	1.76
Sediment management in complementary system building	A36	0.67		Valid	1.88
Vegetation management in complementary system building	A37	0.669		Valid	1.87
The existence of monitoring evaluation system	A38	0.608		Valid	1.7
<i>Storage Systems (A4)</i>	A4		<i>0.829</i>	<i>Reliable</i>	<i>14.93</i>
Type of storage system selection	A41	0.596		Valid	1.64
Determination of storage system number and capacity	A42	0.672		Valid	1.85
Determination of storage system location	A43	0.72		Valid	1.99
Waste management in storage system	A44	0.673		Valid	1.86
Water quality management in storage system	A45	0.624		Valid	1.72
Sediment management in storage system	A46	0.743		Valid	2.05
Vegetation management in storage system	A47	0.717		Valid	1.98
The existence of monitoring evaluation system	A48	0.667		Valid	1.84
<i>Pump Systems (A5)</i>	A5		<i>0.81</i>	<i>Reliable</i>	<i>14.59</i>
Type of pump system selection	A51	0.705		Valid	1.95
Determination of pump system number and capacity	A52	0.725		Valid	2
Determination of pump system location	A53	0.73		Valid	2.02
Waste management in pump system	A54	0.688		Valid	1.9
Water quality management in pump system	A55	0.435		Valid	1.2
Sediment management in pump system	A56	0.687		Valid	1.9
Vegetation management in pump system	A57	0.626		Valid	1.73
The existence of money system	A58	0.685		Valid	1.89
<i>Government Role (B1)</i>	B1		<i>0.838</i>	<i>Reliable</i>	<i>15.1</i>
Determination of O&M organization	B11	0.509		Valid	0.92
Determination of supporting personnel O&M organization	B12	0.61		Valid	1.1
Determination of supporting personnel number	B13	0.653		Valid	1.18
O&M drainage infrastructure on regular schedule	B14	0.537		Valid	0.97
Determination of local government support on O&M budget	B15	0.508		Valid	0.91
Determination of local government support on O&M development and rehabilitation budget	B16	0.597		Valid	1.08
Determination of development and rehabilitation priority	B17	0.668		Valid	1.2
Formation coordination organization among stakeholder	B18	0.572		Valid	1.03
Giving reward to local government	B19	0.428		Valid	0.77

Indicator	Code	Validity Loading Factors	Reliability Cronbach Alpha	Description	Weighting Value
The existence of local laws and regulations & policies that support ecodrain concept	B110	0.667		Valid	1.2
Application of punishment/penalty	B111	0.503		Valid	0.91
Socialization of local laws / regulations, policies and penalty to the community	B112	0.657		Valid	1.18
Involvement of customary institutions in socialization	B113	0.513		Valid	0.92
Follow up on community complaints	B114	0.494		Valid	0.89
Determination of ecodrain master plan	B115	0.467		Valid	0.84
<i>Community Participation (B2)</i>	B2		0.806	<i>Reliable</i>	14.52
Community Participation on drainage infrastructure regular maintenance	B21	0.6		Valid	1.65
The community's active role on reporting drainage infrastructure breaking/failure	B22	0.68		Valid	1.87
The community's active role on reporting inundation	B23	0.676		Valid	1.86
The community's active role on giving post development impact data	B24	0.748		Valid	2.06
Community Participation on drainage infrastructure planning and construction process	B25	0.685		Valid	1.89
The community's active role on infiltration wells construction	B26	0.629		Valid	1.73
Community understanding about ecodrain concept	B27	0.65		Valid	1.79
Community's ability to finance infrastructure damage	B28	0.606		Valid	1.67

Based on Table 1 (weighting value result), it can be seen that the most influential indicator on technical management variable is storage system while on non-technical management variable is government role. The most influential factor from each indicator can be seen on Figure 1.

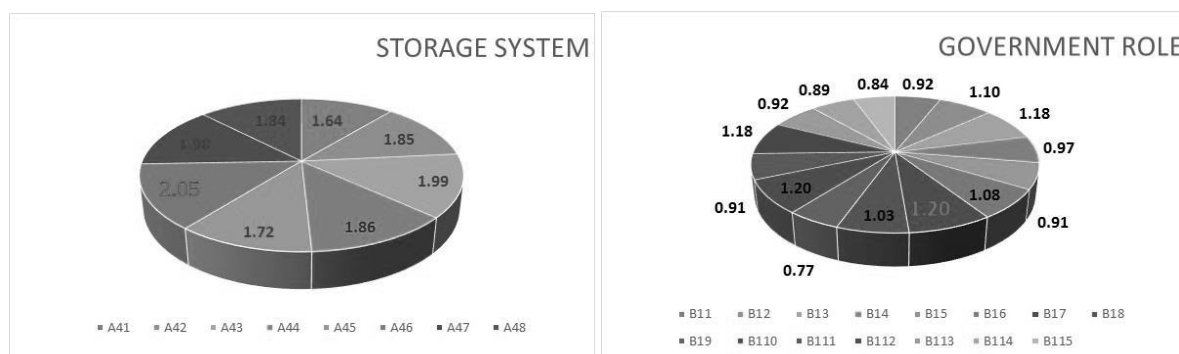


Figure 1. Most influential indicator and factor for ecodrain assessment.

4. Conclusion

It can be conclude that the most influential indicator on technical management variable is storage system while on non-technical management variable is government role. For storage system, the most

influential factor for ecodrain assessment is Sediment management in storage system (with weighting value of 2.05) and for government role the most influential factor for ecodrain assessment is Determination of development and rehabilitation priority (with weighting value of 1.20). Therefore, the most influential factors should be prioritized to identify the implementation of ecodrain concept in an area.

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