Green *Sukuk*-Based Project on Sustainable Waste Management in Indonesia

Happy Febrina Hariyani[1], Hendra Kusuma[2]

Abstract. *Green Sukuk-Based Project on Sustainable Waste Management in Indonesia. Most of the problems that occur in waste management are related to financing. This study proposes Green Sukuk to be used by the government as a diversification of funding for municipal waste management. This paper argues that Green Sukuk can potentially be an Islamic finance instrument for financing municipal substantial waste management project carried out by the Ministry of Environment and Forestry. Further, there will be costs and benefits obtained by the government as the implications of this financing. Hence, this paper attempts to find the best alternative of Sukuk strategy to be implemented in the financing of municipal waste management using Analytic Network Process (ANP) with a network of Benefit, Opportunity, Cost, Risk (BOCR) analysis.*

Keywords: *Sustainable waste management; Green Sukuk; ANP-BOCR*

Abstrak. *Proyek Berbasis Sukuk Hijau untuk Pengelolaan Sampah Berkelanjutan di Indonesia. Sebagian besar masalah yang terjadi dalam pengelolaan limbah adalah pembiayaan. Oleh karena itu, untuk mengatasi masalah ini, pemerintah dapat menggunakan Sukuk hijau sebagai diversifikasi pendanaan untuk pengelolaan limbah kota. Penelitian ini menunjukkan bahwa Sukuk Hijau berpotensi menjadi instrumen keuangan Islam untuk membiayai proyek pengelolaan limbah padat kota yang dilakukan oleh Kementerian Lingkungan Hidup dan Kehutanan. Lebih lanjut, pemerintah memiliki potensi dan peluang untuk mengimplementasikan sistem pembiayaan ini; namun juga menghadapi potensi beban dan kerugian sebagai implikasi dari pembiayaan ini. Oleh karena itu, penelitian ini berupaya menemukan strategi alternatif berupa produk Sukuk terbaik untuk diimplementasikan dalam pembiayaan pengelolaan limbah kota, dengan menggunakan Analytic Network Process (ANP) dan jaringan Analisis Manfaat, Peluang, Biaya, Risiko (BOCR).*

Kata kunci: *Pengelolaan limbah berkelanjutan; Sukuk hijau; ANP-BOCR*

[1]Correspondent Author
[1, 2]Muhammadiyah Malang University, Indonesia
E-mail: [1]happyfebrina@umm.ac.id, [2]hendrakusuma@umm.ac.id

Introduction

Being the 4th largest population in the world makes Indonesia produce a large amount of waste, especially municipal waste. The Ministry of Environment and Forestry (2018) recorded that national waste production is over 65,8 million tons per year, and 60 percent of the total waste is domestic or household waste. 38,5 million tons per year total domestic waste generation in Indonesia ended up in the landfill sites that have been operated as open dumpsites rather than sanitary landfills.

Indonesia relies very much on landfill. Sixty-nine percent of the total waste goes to landfill. Indonesia has more than 200 landfill sites, but they are not even good. Only ten percent of the landfill sites have good sanitary landfill technologies. These landfills are struggling to cope with the ever-increasing waste as the population grows, and people consume more. Increasing population, urbanization and community living standards have led to the increased municipal waste in developing countries (Minghua et al., 2009). Only a small fraction of the collected waste was treated by recycling, composting or incinerating. One of the significant challenges for developing country is managing and providing effective and sustainable waste management. Several solid management projects have been carried out in collaboration with external support agencies. Some projects were successful, but most could not support themselves or expand further when the external agencies discontinued their input due to the lack of organization, financial resources, complexity and system multidimensionality (Burnley, 2007). Moreover, the technology fails because it is centrally organized, heavily subsidized, lacking in community cooperation, and is reliant on disposal (Supriyadi et al., 2000).

Most of the problems that occur in waste management are financing. The high costs required for the procurement of municipal solid waste management technology, as well as high management and maintenance costs, makes some of the existed projects stopped. Therefore, to overcome these problems, the government can use sharia bond as a diversification of funding for building the waste management infrastructure. Infrastructure financing through sharia bond or Sovereign *Sukuk* issuance has been implemented since 2010, namely Project-Based *Sukuk* (PBS) series (Ministry of Finance, 2017).

The development of Indonesian Sovereign *Sukuk* in 2016 has provided encouraging results. Indonesia, as the big *Sukuk* issuer has a total issuance of USD 10,5 billion from the total issuance of *Sukuk* by the government

around the world (Suherman, 2016). In the middle of the development of *Sukuk* instruments, green bond appears as an instrument that offers investment in environmental development to overcome the problem of climate change. With the presence of the green bond as an investment instrument for the environment, a sharia investment instrument has emerged, which has the same concentration as the green bond. The instrument is then called Green *Sukuk*.

From the discussion above, this paper argues that Green *Sukuk* can potentially be an Islamic finance instrument for financing municipal solid waste management project carried out by the Ministry of Environment and Forestry. Further, the government has several advantages and opportunities, and also burdens and losses as the implications of this financing. Hence, this paper attempts to find the best alternative *Sukuk* strategy to be implemented in the financing of municipal solid waste management using Analytic Network Process (ANP) with a network of Benefit, Opportunity, Cost, Risk (BOCR) analysis.

Literature Review

Green Bond and Green *Sukuk*

Due to the high impact of global warming, The World Bank pioneered the issuance of Green Bond as an effort to finance infrastructure that supports the reduction of carbon emission. The World Bank first issued the development of the concept of Green Bond in 2008 as part of the "Strategic Framework for Development and Climate Change". This concept is also in response to the increasing demand of investors who want to invest in financing instruments related to global climate change and the action of saving the earth (Hariyanto, 2017).

Indonesia has a role in supporting programs to reduce global warming and its impact. As a trusted *Sukuk* issuer, Indonesia should use *Sukuk* as a financial instrument that can be used to support that program. The development of infrastructure in various sectors, run intensively by the Government, has a huge potential to develop Green *Sukuk*. The government also has an integrated infrastructure development program contained in the Master Plan for Acceleration and Expansion of Indonesian Economic Development (MP3EI).

The infrastructure development program in MP3Ei is in line with the concept of Green *Sukuk*. For this program to be in line with the carbon emission reduction program, it seems necessary to align the infrastructure development program in MP3EI with the concept of green infrastructure.

Analytical Network Process

According to Ascarya (2010), ANP is a non-parametric non-Bayesian qualitative approach to the decision-making process with a general framework without making assumptions. This method was first developed by Thomas L. Saaty, who is a developer of the Analytic Hierarchy Process (AHP) method. ANP is a new approach in the decision-making process without making assumptions.

There are three basic principles of ANP, namely decomposition, comparative assessment, and composition or synthesis (Ascarya, 2010). Decomposition is intended to structure complex problems into a hierarchical framework or network of clusters, sub-clusters, and so on. The Comparative assessment is to build a pairwise comparison of all combinations of elements contained in the cluster to get local priority. The last is the composition. The composition is intended to divert local priorities from elements in the cluster with global priorities from the parent element, which in turn will produce global priorities in the entire hierarchy.

ANP has three main functions. The first is to measure complexity hierarchically into homogeneous clusters of factors to model the problem into the ANP framework then. The Second is the measurement of the ratio scale, which is believed to be accurate in measuring the factors that make up the hierarchy. Measurement of this ratio is needed to reflect proportions. The last is synthesis, which unites all the parts that have been decomposed and measured into one unit (Ascarya, 2010).

Benefit-Opportunity-Cost-Risk Analysis

According to Saaty and Vargas (2006), in research with the BOCR network, the relationship between Benefits, Opportunity, Cost and Risk is influenced by general factors. Benefit, Opportunity, Cost and Risk (BOCR) analysis is an analysis of priority determination based on the results of the calculation of the desired criteria as benefits and criteria that are not desired as a burden (Cost). In addition, there are also criteria based on future events that may occur as positive things (Opportunity) and things that can lead to harmful risks. In the analysis, the calculation is done by pairwise comparison (Saaty, 2001). The resulting decision is divided into three parts, namely the assessment system, merits of the BOCR decision as a consideration for making decisions, and a network of objective relationships that make an alternative decision more desirable than others.

Methods

Source and Data Collection Method

This research uses primary data obtained from an in-depth interview with experts and practitioners to understand the problem comprehensively in order to synthesize the problems and make it in priority. The consideration in choosing the respondents is by their understanding of green *Sukuk* and its implementation for financing sustainable waste management in Indonesia.

Three respondents are from experts who are professor and lectures from university, and the other four respondents are from the Ministry of Environment and Forestry and Ministry of Finance as the practitioners related to the topic discussed.

Methodology

This research is qualitative-quantitative analysis research that aims to capture a value or view that is controlled by regulators, academics and practitioners about Green *Sukuk* based project on sustainable waste management. The analytical tool used is the Analytic Network Process (ANP) with Benefit, Opportunity, Cost and Risk (BOCR) networks that are processed using Microsoft excel software and Super Decision software.

ANP methodology is done in three steps. First, questionnaires and in-depth interviews with scholars, experts, practitioners, and regulators of Green *Sukuk* financing on sustainable waste management are conducted to comprehend the real problems. Second, the results of the preliminary stage are used to develop an appropriate ANP network and relevant questionnaires to glean the necessary of the data from experts and practitioners from Islamic Finance, particularly in Green *Sukuk* and also sustainable waste management. Third, ANP analysis is applied to set the priority alternative solutions and policy strategies in order to formulate policy recommendations.

Analytical Network Process (ANP) Method

The ANP method is widely used in research on policy, strategic management and various studies related to decision making. These include Wang & Hsu (2003) analyzing the right channel as a continuation of the ANP method for convenience stores in Taiwan to meet the challenges of competition and the application of ANP for supports weighting in designing performance appraisal

systems and selection of partners and future strategic business alliances (Boran, 2008; Chen, 2008). The number of samples/respondents in ANP does not serve as a benchmark for validity. Valid conditions for respondents in ANP are that they are experts in their fields.

Saaty & Vargas (2006) stated that ANP has four axioms on which to base its theory. The axiom serves to strengthen a statement so that truth can be seen without evidence (Tanjung & Devi, 2013). These axioms include Reciprocal, homogeneity, priority and dependence condition. With regards to reciprocal, this axiom states that if PC (EA, EB) is the comparative value of pairs of elements A and B, then it is seen from the parent element C, which shows how many times element A has what element B has, then PC (EB, EA) = 1 / PC (EA, EB). For example: if A is five times bigger than B, then B is 1/5 of the magnitude of A.

The axiom of Homogeneity, axiom states that the element to be compared does not have an extensive comparison that can cause a more significant error in determining the assessment of supporting elements that influence the decision to be taken. Priority, means absolute weighting using the interval scale [0,1] and as a measure of relative dominance. Dependence Condition assumes that the composition can be composed into components that form part of a cluster. Tanjung & Devi (2013) explained that there are three basic principles in ANP, which include decomposition, comparative assessment, consistency and hierarchical composition (synthesis).

Data Analysis

Data and information from experts and practitioners are arranged in the form of a framework model. If the questionnaire regarding opinions has been collected, then the next step is processing the data using Microsoft Excel software and SuperDecision software. The questionnaire was put into pairwise comparison, between elements in the cluster and between clusters to find out which one gives more significant influence seen from one side. The results from the BOCR network from respondents will be put together. The data is then processed through Microsoft. The next step is to calculate the geometric mean and rater agreement.

The first is to calculate the Geometric Mean. Geometric Mean is used to determine the individual judgment of the respondents and to get the opinion of respondents. Geometric Mean is a type of average calculation that shows a

certain trend or value (Ascarya, 2012). The formulation is as follows:

GMk = (R1 * R2 ... n) 1 / n

Description:

GM   = Geometric Mean

R   = Respondents

n   = Number of Respondents

The Second is to calculate the rater agreement. Tanjung & Devi (2013) defined that the Rater agreement is the value of the agreement between respondents. So rater agreement is a measure that shows the level of conformity or agreement of the respondents (R1-Rn) to a problem in one cluster. The tool used to measure the rater agreement is Kendall's Coefficient of Concordance (W, 0 <W <1). W = 1 shows perfect conformity (Ascarya, 2012). The formula to get the value of W is as follows:

U = (T1 + T2 ... + Tp) / P

S = (T1-U) 2+ (T2-U) 2 + ... + Tp-U) 2

Maxs = (n-U) 2+ (2n-U) 2 + ... + (pn-U) 2

W = S / MaxS

Description:

U   = Average Value of Total Ranking

S   = Number of Deviation Squares

P   = Number of Nodes

N   = Number of Respondents

T   = Total

Benefit, Opportunity, Cost, Risk in Green *Sukuk* Based Project on Sustainable Waste Management

Criteria and elements used in this research are derived from the review of literature studies related to benefits, opportunities, cost and risk for the Green *Sukuk* based project on sustainable waste management and alternative strategies that will be offered.

Figure 1. Conceptual Framework
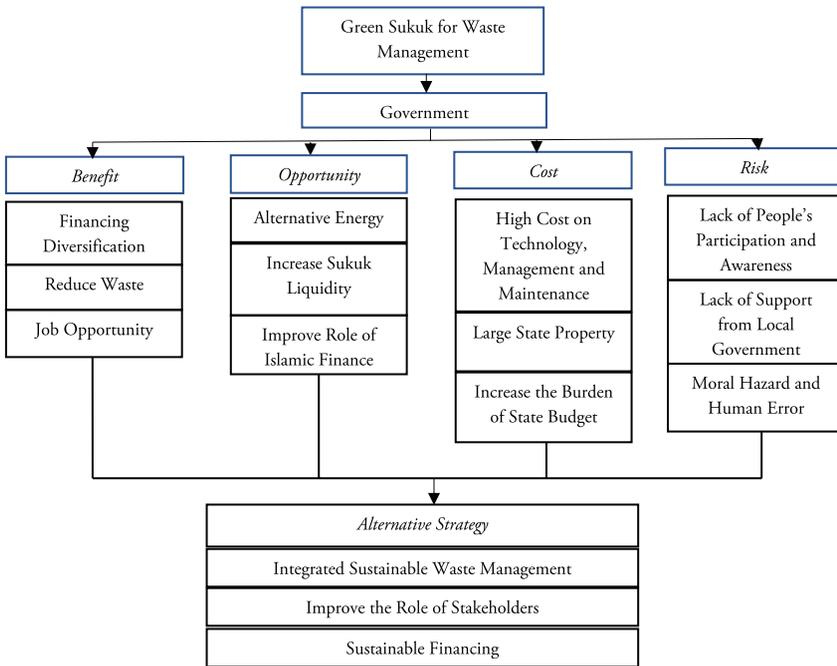
Problems in the implementation of Green *Sukuk* in municipal waste management financing are reviewed from one aspect, namely the Government aspect. Overall, clusters are grouped into aspect and strategy clusters. The problem in this model uses a one-floor Benefit Opportunity Cost Risk (BOCR) network approach as strategic analysis. For more details, the division of clusters with several aspects of the research node can be seen in the following conceptual framework in Figure 1.

Results and Discussion

Problem Identification

After in-depth interviews are done, BOCR framework analyzes the cluster of Benefit, Opportunity, Cost, and Risk, which each of them has three elements and an alternative cluster strategy has three elements. The Benefit cluster includes: 1) financing diversification, 2) reduce waste, and 3) job opportunity. The Opportunity cluster are: 1) alternative strategy, 2) *Sukuk* liquidity increase, and 3) the improvement the role of Islamic finance. The Cost cluster are: 1) high cost on technology, management and maintenance, 2) large state property,

and 3) the increase of state budget burden (APBN). The Risk cluster include: 1) the lack of people participation and awareness, 2) the lack of support from local government, and 3) moral hazard and human error. The Alternative Strategy cluster includes: 1) integrated sustainable waste management, 2) the improvement of the role of stakeholders, 3) sustainable financing.

Synthesis and BOCR Results

Each decision has several right and wrong possibilities that must be considered. In the ANP method, the excellent possibility is called Benefit. In contrast, the wrong possibility is called Cost. The possibility that is not yet certain is called Opportunity. Meanwhile, the possibility that will be obtained from the decision is called risk (Saaty & Vargas, 2006).

The results of the synthesis of the model and overall priorities are based on four aspects that control the selection criteria of the strategy through the combination of experts' opinions. Normalized BOCR aspects are used as the basis for determining priorities. The BOCR aspect with the highest normalization value has the highest rating and vice versa. The synthesis results show that the benefit aspect as the first rank has normalized value and limiting value which is far greater than the cost aspect as the last rank, which is shown in Table 1.

Table 1. Pairwise Comparison Results of the Green *Sukuk* Based Project on Sustainable Waste Management Based on the Aspects of BOCR Model

Aspect of BOCR Model	Average Value	Ranking
Benefit	0,31	1
Opportunity	0,22	3
Cost	0,21	4
Risk	0,25	2

Source: Processed Data (2020)

Based on the ANP-BOCR analysis in Table 1, the Benefit aspect becomes the top priority of the four criteria with the average value of 0,31. That is, in the selection of strategies for financing sustainable waste management using green *Sukuk*, it must provide the most significant benefit. The second priority is the Risk aspect with the average value of 0,25. Third priority is the Opportunity aspect with the average value of 0,22. Whereas for the lowest ranking with the

average value of 0,21 is cost aspect which shows that there is a cost required that becomes the lowest priority compared to other aspects.

Table 2. Pairwise Comparison – Benefit Cluster

Benefit	Average Value	Ranking
Financing Diversification	0,45	1
Reduce Waste	0,33	2
New Job Opportunity	0,22	3

Source: Processed Data (2020)

Table 2 shows the pairwise comparison from the Benefit aspect. The top priority of the three elements is financing diversification with an average value of 0.45. The second priority is reducing waste with an average value of 0.33. The last priority is a new job opportunity with an average value of 0.22. Financing diversification of funding as the development program of government, specifically at the Ministry of Environment and Forestry.

Table 3. Pairwise Comparison – Opportunity Cluster

Opportunity	Average Value	Ranking
Alternative Energy Source	0,37	1
Increase *Sukuk* Liquidity	0,30	3
Improve the Role of Islamic Finance	0,33	2

Source: Processed Data (2020)

The results of the pairwise comparison of Opportunity cluster can be seen in Table 3, where the main priority is the alternative energy source element with an average value of 0.37. The second priority is on improving the role of Islamic finance with an average value of 0.33. As for the last priority, there is an increase in liquidity *Sukuk* element with a value of 0.30. This result is in line with what it has been stated by Sharholy *et al.* (2008); Srivastava *et al.* (2005); Turan *et al.* (2009) that waste can be an effective alternative energy source to reduce landfill waste produced by households. This energy source can be used as alternative energy to replace electricity.

Table 4. Pairwise Comparison – Cost Cluster

Cost	Average Value	Ranking
High Cost on Technology, Management, and Maintenance	0,38	1
Large State Property	0,37	2
Increase the Burden of State Budget (APBN)	0,26	3

Source: Processed Data (2020)

The pairwise comparison results for cost cluster shown in table show that the element that becomes the top priority in financing sustainable waste management through Green *Sukuk* is the high cost on technology, management, and maintenance element with a value of 0.38. The large state property element becomes the second priority, with an average value of 0.37. As for the last priority with an average value of 0.26, there is an increase in the burden state budget (APBN) element. Sharholy *et al.* (2008) stated that the high cost needed to procure household waste management technology, as well as the high management and maintenance costs.

Table 5. Pairwise Comparison – Risk Cluster

Risk	Average Value	Ranking
Lack of People's Participation and Awareness	0,42	1
Lack of Support from Local Government	0,35	2
Moral Hazard and Human Error	0,22	3

Source: Processed Data (2020)

Based on the pairwise comparison on risk cluster shown in table 5, the priority of the three elements is the lack of people's participation and awareness with an average value of 0.42. The second priority is the lack of support from the local government, with an average value of 0.35. The last priority is moral hazard and human error with an average value of 0.29. Community participation and awareness are essential in achieving the objectives of the recommended management system, but it is difficult and takes a long time to make people aware of the importance and principles of the proposed management system and to influence their participation (Srivastava *et al.*, 2005; Turan *et al.*, 2009)

Table 6. Pairwise Comparison – Alternative Strategy

Alternative Strategy	Average Value	Ranking
Integrated Sustainable Waste Management	0,41	1
Involve the Role of Stakeholders	0,34	2
Sustainable Financing	0,25	3

Source: Processed Data (2020)

Table 6 shows the pairwise comparison of the alternative strategy. The top priority is integrated sustainable waste management with an average value of 0.41. The second priority is to involve the role of stakeholders with an average value of 0.34. In contrast, the last priority is sustainable financing with an average value of 0.25. In accordance with the Law of the Republic of Indonesia Number 18 the Year 2008 concerning Waste Management, which requires all 504 regions in Indonesia to have: "Integrated waste treatment location, collection, sorting, recycling, handling, and final waste processing" The final waste disposal must be in sanitary landfills. Integrated Solid Waste Management (ISWM) is a comprehensive approach to preventing, recycling and managing solid waste in the most effective way to protect public health and the environment. This includes updating the waste processing technology at the landfill area (TPA) (Klundert & Anschutz, 2001; Zhang *et al.*, 2010; Zurbrügg *et al.,* 2012)providing an overview of the current state of MSW management, an analysis of existing problems in MSW collection, separation, recycling and disposal, and some suggestions for improving MSW systems in the future. In China, along with urbanization, population growth and industrialization, the quantity of municipal solid waste (MSW

Conclusion

Implementing Green *Sukuk* on financing sustainable waste management in Indonesia has three benefits: 1) finance diversification, 2) reduce waste, and 3) job opportunity. The opportunities available are: 1) alternative energy, 2) the increase of *Sukuk* liquidity, and 3) the improvement of the role of Islamic finance. The potential Costs are: 1) high cost in technology, 2) large state property, 3) the increase of the burden of the state budget (APBN). Meanwhile, the Risk includes: 1) thr lack of people's participation, 2) the lack of support from local governments, 2) moral hazards and human errors. The priority from benefit, on the other hand, is financing diversification. The priority in the Opportunity

cluster is an alternative energy source, while the main priority in the Cost cluster is a high cost in technology, management, and maintenance. Furthermore, The main priority in risk cluster is the lack of people's participation and awareness priority. The last is the strategy cluster, in which the main priority is integrated sustainable waste management.

References

Ascarya. 2012. *Analytic Network Process (ANP): Pendekatan Baru dalam Penelitian Kualitatif (Konsep Dasar).* Jakarta.

Boran, S. 2008. A Study On Election Of Personnel Based On Performance Measurement By Using Analytic Network Process (ANP), *8*(4), 333–338.

Burnley, S. J. 2007. A review of municipal solid waste composition in the United Kingdom. *Waste Management*, *27*(10), 1274–1285. https://doi.org/10.1016/j.wasman.2006.06.018

Chen, S. 2008. Applying the ANP approach to partner selection for strategic alliance, *46*(3), 449–465. https://doi.org/10.1108/00251740810863889

Klundert, A. van de, & Anschutz, J. 2001. *Integrated Sustainable Waste Management. Waste.* https://doi.org/90-76639-02-7

Minghua, Z., Xiumin, F., Rovetta, A., Qichang, H., Vicentini, F., Bingkai, L., … Yi, L. 2009. Municipal solid waste management in Pudong New Area, China. *Waste Management*, *29*(3), 1227–1233. https://doi.org/10.1016/j.wasman.2008.07.016

Saaty, T. L., & Vargas, L. G. 2006. *Decision Making With The Analytic Network Process. Economic, Political, Social dan Technological Applications with Benefits, Opportunities, Cost dan Risks.* Pittsburgh: Springer.

Sharholy, M., Ahmad, K., Mahmood, G., & Trivedi, R. C. 2008. Municipal solid waste management in Indian cities - A review. *Waste Management*, *28*(2), 459–467. https://doi.org/10.1016/j.wasman.2007.02.008

Srivastava, P. K., Kulshreshtha, K., Mohanty, C. S., Pushpangadan, P., & Singh, A. 2005. Stakeholder-based SWOT analysis for successful municipal solid waste management in Lucknow, India. *Waste Management*, *25*(5), 531–537. https://doi.org/10.1016/j.wasman.2004.08.010

Suherman. 2016. Identifikasi Potensi Penerbitan Green *Sukuk* di Indonesia. *Jurnal Ilmiah Mahasiswa FEB Universitas Brawijaya*, *5*(1). Retrieved from Jurnal Ilmiah Mahasiswa FEB Universitas Brawijaya

Supriyadi, S., Kriwoken, L. K., & Birley, I. 2000. Solid waste management solutions for Semarang, Indonesia. *Waste Management & Research*, *18*(6), 557–566. https://doi.org/10.1177/0734242X0001800606

Tanjung, H., & Devi, A. (2013). *Metodologi Penelitian Ekonomi Islam.* Jakarta: Gramata Publishing.

Turan, N. G., Çoruh, S., Akdemir, A., & Ergun, O. N. 2009. Municipal solid waste management strategies in Turkey. *Waste Management*, *29*(1), 465–469. https://doi.org/10.1016/j.wasman.2008.06.004

Wang, B., & Hsu, M. 2003. Application of the Analytical Network Process to Select a Channel Type for E-convenient Chain Stores- ANP. *An International Journal*, 236-278.

Zhang, D. Q., Tan, S. K., & Gersberg, R. M. 2010. Municipal solid waste management in China: Status, problems and challenges. *Journal of Environmental Management*, *91*(8), 1623–1633. https://doi.org/10.1016/j.jenvman.2010.03.012

Zurbrügg, C., Gfrerer, M., Ashadi, H., Brenner, W., & Küper, D. 2012. Determinants of sustainability in solid waste management - The Gianyar Waste Recovery Project in Indonesia. *Waste Management*, *32*(11), 2126–2133. https://doi.org/10.1016/j.wasman.2012.01.011