



The Communication Network in Community-Based Solid Waste Management (Waste-Bank) In Makassar, Indonesia

MA Wellang^{1,3}; T Matsumoto^{1,2}.

¹Graduate Programs in Environmental Systems, Graduate School of Environmental Engineering, The University of Kitakyushu, Kitakyushu, 808-0135, Japan

²Research Centre for Urban Energy Management, Institute of Environmental Science and Technology, The University of Kitakyushu, Kitakyushu, 808-0135, Japan

³Department of Sociology, Faculty of Political and Social Science, Bosowa University, Makassar, 90232, Indonesia

INFO ARTICLE

* Corresponding author; :
m.mallagennie@gmail.com

Keywords:

communication network;
social network analysis;
waste bank.

ABSTRACT

The Waste Banks initiative, which has been in operation in Makassar City since 2013, attempts to alleviate Indonesia's waste problem by encouraging community participation in garbage separation within the framework of community-based waste management (CBWM). Despite its extensive history, no significant progress has been made. This study dives into the communication network of waste bank players in Makassar City, concentrating on the three best performance Waste Banks. Data gathering included interviews and questionnaires with each participant, and communication networks and sociograms were analyzed using Social Network analytic (SNA) and the UCINET 6 analytic tool. The major findings reveal a startlingly low network density of 1% in each waste bank (Lamber Borong: 0.063, Sayang Rennu: 0.032, Sayang Rennu: 0.032). Members' low level of active communication is shown. Furthermore, each waste bank identifies a member with the highest degree of centrality, detailing communication pathways and emphasizing that single person's importance. In contrast, an individual with the lowest closeness centrality score in each waste bank displays their capacity to efficiently disseminate information throughout the network. Furthermore, several people in each waste bank have a high betweenness centrality score, highlighting their vital role in linking others inside the trash bank network.



INTRODUCTION

Humans and the environment influence each other, even the quality of human life depends on the environment. Quality of human life will be difficult to achieve when the environment is unhealthy. Quality of life refers to several things, one of the main ones is the issue of health services, in general including issues related to sustainable development (Uzzell and Moser, 2006). Many factors cause the emergence of disease and health problems, such as air pollution, air pollution, and an unhealthy environment, (Rumambi, 2023), and waste is a cause of environmental pollution. In Indonesia, data from the Ministry of Environment and Forestry states that total waste production reached 67.8 million tons in 2020, (Setiawan, 2021) With a population of 270 million, each resident produces 0.68 kilograms of waste every day. This number increased in 2021, namely 68.5 million tonnes, with plastic waste accounting for 17% as the largest contributor (2022). This number shows a tendency to increase every year, including in Makassar City, which is shown by data from the Makassar Environmental Service that the average increase in waste is around 11.53 percent every year (chandra, 2023). Based on national waste management data (Capaian Kinerja Pengelolaan Sampah, n.d.), in Indonesia, piles of inorganic waste managed by 3R (reuse, reduce, recycle) reached 3,189,087 tons in 2020, or the equivalent of 9.61 percent when compared to total national waste.

Most inorganic waste sorting activities are in the informal sector at 43.78 percent, further sorting before being sent to the landfill is 35.41 percent and is carried out in the management of 3R waste processing facilities at 11.63 percent. The large percentage of waste managed informally shows the role of non-government actors in supporting the waste management sector, both upstream and downstream management so that the amount of waste landfilled can be reduced (Kubota et al., 2020). Environmental management, including demolition, requires a solid regulatory foundation, strict monitoring, and integration with other fields (Rumambi, 2023). The landfill is the final place where waste is piled up, and currently, the landfill in Makassar City has reached its maximum limit. Support for reducing the amount of waste entering the final disposal side continues to be voiced because the final disposal side has reached a critical point (Fatmawati et al., 2022), (Malina and Muchtar, 2017). A waste bank is defined as a place to store waste that has been sorted and has economic value (Sutiawati et al., n.d.). The waste bank is one of the solution initiatives in community-based waste management (Kubota et al., 2020), because it is an independent and productive waste management system, (Sutiawati et al., n.d.) and empowers the community to care about cleanliness (Saputri et al., n.d.). Makassar City has successfully built approximately 1,000 waste banks as part of a community-based waste management initiative. However, data from the Makassar City Environmental Agency reveals that only around 300 waste banks will actively sell waste to the central waste bank during 2023, (Lestari, 2022).

Government Regulation Number 81 of 2012 concerning the management of household waste and similar types of household waste states that there is a division of tasks and roles between government, non-government, and the community. One important aspect to study in determining the success of a waste bank is the communication aspect that exists in the waste bank system, both internally within the waste bank group and in communication with external parties. To find out the existing communication network, it is important to visualize the existing communication network (P.L.A.I. Shehara et al., 2019), where before that identification of the actors and the roles of the actors involved in the communication network is carried out. Networks in a group or organization can function to control the flow of communication, for individuals who have similar interests to gather and interact, establish common interpretations, increase influence, and for the exchange of information. A network is a social structure born from communication between individuals or group. The study of communication networks is a multidisciplinary science and a development of social sciences (social network) (Utami, 2018).

In this communication network analysis, further stakeholders will be found who are involved in the success of a group in achieving goals, (Reed et al., 2009), (Luo and Zhong, 2015). By knowing the key actors involved, information will be obtained to manage the waste bank organization more effectively and efficiently (Gimnastiar et al., n.d.), because it is known that the position of actors in communication networks is the key to the success of waste bank management (Sulistiawati, 2014). In addition, knowing the key actors in the network



will facilitate the distribution of information to all members in the network (Hongwei et al., 2022). Following these insights, we aim to enrich the empirical perspective of the communication networks in waste bank by examine the existing communication network in the active waste bank in Makassar City, as well as identify the role of the significant actors involved in the active waste bank. Even though Waste-Bank as a Community Solid Waste Management has been studied but as far as we know, the study that focusing on actor relation has never been carried out before using social network analysis (SNA) in Makassar. We look this as beneficial as a baseline to understand how to improve the existing waste-bank particularly in gaining the community participation through a good leadership and information distribution.

METHOD

A popular method for studying natural resource governance and management is social network analysis (SNA) (Prell et al., 2009a). The researched system is represented as a network of nodes and ties in SNA. Individuals, institutions, or things can be nodes, and ties are the connections between them. (Wasserman and Faust, 1994). This research was conducted in Makassar City, South Sulawesi Province, Indonesia. The survey was carried out at 3 waste bank units, they are Asoka V, Lamber Borong, and Sayang Rennu. These three waste bank units were chosen because they are considered the best waste bank in Makassar with the highest sales of recycled waste during 2021, and active members in the sense of having many customers and having a transaction record book. Waste bank data with these criteria was obtained from the Makassar City Environmental Agency in 2021, and 3 waste bank units were obtained which were used as data collection sites for this research.

Table 1. Profile of the Community-Based Solid Waste Management (Bank Sampah) – The Makassar Environmental Agency

	Waste Bank Unit		
	Lamber Borong	Sayang Rennu	Asoka V
Costumer	25	110	76
Ward	Borong	Tamamaung	Jongaya
Sub-district	Manggala	Panakkukang	Tamalate
Management	Agus Salim	Halimah	Faisal Baso
Year Of Establishment	2016	2016	2015
Recyclable Waste Collected, 2021 (Kg)	10247	15370	15512
Revenue, 2021 (Rp)	44.899.800	44.705.800	40.103.900

The determination of respondents in this study used the *intact sampling* method, which takes all individuals in the system as samples.(Siregar et al., 2020). Data was collected through interviews by visiting waste bank customers directly at the waste bank locations in Tamalate, Manggala, and Panakukang sub-districts. The number of participants expected to participate was 210. However, only about 181 (85%) of the members participated. The data obtained was then entered into a matrix in Edgelist format with directed version (nodes to nodes) (Fig. 2). The data was then analyzed using UCINET 6.7 software for SNA (social network analysis). SNA can be viewed as a more graphical technique for visualizing network behavior (P.L.A.I Shehara et al., 2019) (Falcone et al., 2020). Ucinet 6.7 software displays network density, degree centrality, betweenness centrality, and closeness centrality. This softwasre, which is equipped with Netdraw facilities can display network sociograms formed by each actor (Pratama, 2020). the relationship between each actor can be described more easily and clearly with this tool.

This survey aims to explore the relationships among actors within a network, focusing on the aspect of information dissemination about the Waste Bank. The customers of each Waste Bank are identified from the



Waste Bank membership data, and all these members are included in the questionnaire. The question posed to reveal these relationships is, "To whom do you inquire for information about the Waste Bank?" Each actor can select the name of a member within their respective organization. This type of relationship is termed "directed (Fig.1)." In a directed relationship, there exist senders and receivers, or subjects and objects (Eriyanto, 2014). While the relationship is undirected, there is no sender and receiver, both actors have the same message. (D'Andrea et al., 2010). Ties may be directed or undirected. The information transfer has a direction (sender to receiver) in directed ties but no direction in undirected relationships. A range of mathematical methods may be used to study the formulation and representation of networks in SNA. (Wasserman and Faust, 1994)

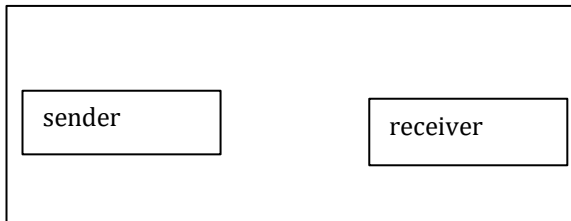


Fig1. Directed

Senders	receivers
ACTOR A	ACTOR C
ACTOR A	ACTOR B
ACTOR B	ACTOR E

Fig. 2 Edgelist Matrix

RESULT AND DISCUSSION

Network Density and Centrality Measures

a. Network Density

Network density is a measure of the overall connectivity between members within a network. A higher density indicates a more interconnected network where members frequently interact with each other (Webster and Morrison, 2004). In this study, the calculated densities are 0.063 for Lamber Borong, 0.032 for Sayang Rennu, and 0.082 for Asoka V. These values, all below 1%, indicate very low network density. This sparse connectivity could imply challenges in information dissemination and collective decision-making within these units.

b. Degree Centrality

Degree centrality measures the number of direct connections an actor has within the network. Table 2 shows the degree centrality scores for the highest-scoring actors in each Waste Bank Unit: actor 15 (Faisal Baso - Asoka V) with a score of 165, actor 38 (Halimah - Sayang Rennu) with a score of 85, and actor 1 (Agussalim - Lamber Borong) with a score of 19. These results indicate that these actors serve as central hubs in their respective networks, having the most direct communication paths with other members.

c. Closeness Centrality

Closeness centrality reflects how close an actor is to all other actors in the network. It is calculated as the inverse of the average shortest path distance from the actor to all other actors. For this measure, lower values indicate better centrality. The actors with the lowest closeness centrality scores are actor 15 (55 - Asoka V), actor 38 (122 - Sayang Rennu), and actor 1 (19 - Lamber Borong). This suggests that these actors are well-positioned within their networks to quickly communicate with all other members, highlighting their importance in information dissemination. Actors who are at the center of the network, have a higher probability of occupying Closeness centrality compared to actors who are at the periphery of the network (Prell et al., 2009b).

d. Betweenness Centrality

Betweenness centrality measures the extent to which an actor lies on the shortest path between other actors, indicating their role as intermediaries. High betweenness centrality scores suggest that these



actors are crucial for controlling and facilitating information flow within the network. The highest betweenness centrality scores are: actor 15 (374 - Faisal Baso), actor 38 (2086 - Halimah), and actor 1 (71 - Agussalim). These actors play significant roles as gatekeepers, bridging different parts of the network and potentially exerting considerable influence over the dissemination of information. Their positions enable them to control the flow of information and possibly the dynamics of network interactions. (Prell et al., 2009b).

Table 2. Ucinet 6 Calculation of Network Density and Multiple Centrality Measures

Waste Bank Unit	Network Density	Actor	Degree	Closeness	Betweenness
Sayang Rennu	0,082	No. 38 (Halimah)	241	122	2082
Lamber Borong	0,032	No. 1 (Agussalim)	19	19	71
Asoka V	0,082	No. 15 (Faisal Baso)	165	55	374

Network Display

In the Network Display image, it is clearly visible that the actors Halimah, Faizal Bazo, and Agussalim (Fig.1,2,3) have the largest node sizes. This indicates that the centrality level of these actors is the highest compared to others. High centrality levels suggest that these actors are the most communicative in the network, meaning they provide information or serve as points of inquiry about the Waste Bank to other actors. Nevertheless, information dissemination also occurs among other actors in each network, with smaller node sizes. The distinguishing factor is that actor Agussalim (Figure 3) serves as the central actor in his network, indicating that he is the sole actor who most frequently imparts information to other actors in his network. The network structure formed belongs to the structure of the wheel network and all channels (stars). This indicates that there are central actors in the communication network. (DeVito, 2012).

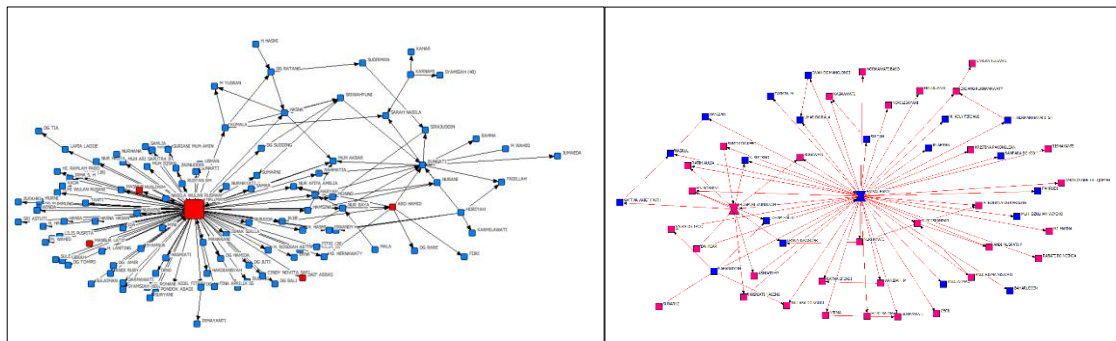


Figure 1. Community-Based Solid Waste Management (Waste Bank) – Sayang Rennu.
 Figure 2. Community-Based Solid Waste Management (Bank Sampah) – Asoka V.

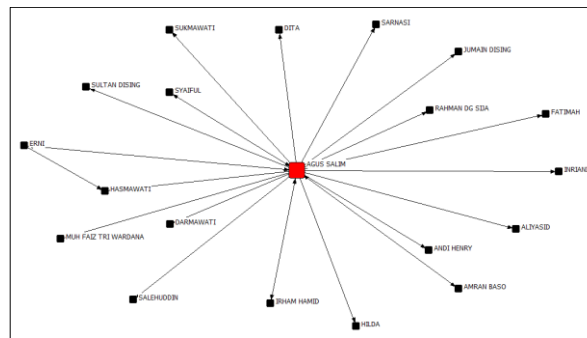


Figure 3. Community-Based Solid Waste Management (Bank Sampah) – Lamber Borong: UCINET 6 Netdraw

Key Actors and Centralized Communication Path

The identification of actors 15 (Faisal Baso-Asoka V), 38 (Halimah – Sayang Rennu), and 1 (Agussalim – Lamber Borong) as central figures in the waste bank network underscores their pivotal role in facilitating information flow. These centralized communication paths show that actors with a high level of centralization play an important role in shaping the dynamics of the network. (Borgatti, 2005). Leveraging the influence of these key actors could be instrumental in improving communication efficiency within the waste bank units. Central actors have the potential to act as opinion leaders. (Juniyanti, n.d.)

Implications of Very Low Network Density

The discussion of network density reveals a surprising finding of very low density among waste bank members, indicating a lack of active communication within the networks. This raises concerns about the effectiveness of information flow and collaborative efforts within waste banks. The exploration of degree centrality, closeness centrality, and betweenness centrality further elucidates the communication dynamics. Actors with the highest degree centrality, such as Faisal Baso, Halimah, and Agussalim, play central roles in information exchange. This situation can pose a threat to the sustainability of a Waste Bank. If there is only one main actor who can be a bridge of information in the organization, then the opportunity to break the information chain can have a negative impact on the sustainability of the organization. The Waste Bank as an institution should exist as a forum that educates its members, not expected to be an institution that is personal ownership of its leader (waste bank management).

The identification of communication gaps within waste bank networks suggests potential areas for improvement. Strengthening internal communication channels and fostering collaboration among waste bank members could enhance the overall efficiency of waste management initiatives. Moreover, leveraging the central actors highlighted in the analysis could facilitate targeted interventions and information dissemination.

Strategic Interventions for Enhanced Communication

The implications derived from the analysis pave the way for strategic interventions aimed at enhancing communication and collaboration within waste bank units. Initiatives such as targeted training programs for key actors, community workshops, or the establishment of communication platforms can be instrumental in addressing the identified challenges. Leveraging the influence of central actors, particularly those with high degree and betweenness centrality, should be a focal point for network management strategies.

CONCLUSIONS

The findings of this study underscore the pivotal role played by specific actors in the dissemination of information within the Asoka Waste Bank Unit. Notably, Actor No 15, Lamber Borong (Actor No 1), and Sayang Rennu (Actor No 38) emerge as central figures, demonstrating significant influence in the network. Their



prominence is substantiated by their high scores in degree centrality and betweenness centrality, indicative of their central and influential positions in the communication network. Additionally, their proximity to other actors is highlighted by the smallest Closeness Centrality values, emphasizing the strength of their connections within the network.

The implications of such centrality extend beyond individual actors, as key figures in communication networks serve as linchpins for the effective dissemination of environmental messages. Whether individuals, organizations, or groups, these actors possess the requisite influence, access, and capacity to amplify messages, thereby enhancing public awareness regarding waste separation. The research unveils the substantial impact of these key actors in fostering community engagement and participation in waste sorting initiatives.

However, the study's discovery indicates a possible disadvantage to the concentration of impact. The increased centrality of certain actors tends to be associated with fewer linkages between other network members, resulting in decreased total network density. While essential actors may excel at promoting certain projects, their strengthened centrality may unintentionally impair links among other actors, thus reducing the network's efficacy.

Furthermore, the study challenges the conventional assumption that a larger customer base inherently correlates with increased sales of segregated waste. Contrary to expectations, the Lamber Borong trash bank, with a modest 25 active customers, emerges as a noteworthy outlier. Despite its relatively smaller customer base, it achieves the highest waste sales in 2021, as evidenced by data from Makassar's environmental agency. This intriguing finding prompts a re-evaluation of the factors contributing to waste sales and suggests that the conventional metrics of customer quantity may not be the sole determinants of success in waste segregation initiatives.

Given these results, the study recommends more research to clarify the precise features that maximize the performance of Waste Bank Units and to go deeper into the dynamics of important players' engagement. To get a deeper knowledge of the variables influencing community participation in trash sorting activities, a request for qualitative study is also made to investigate the reasons for people's participation in trash Banks. This multimodal strategy is considered necessary to improve waste management activities by optimizing the operation of Waste Banks and honing methods, which in turn will increase community engagement. These findings suggest that while the networks may struggle with widespread communication, these key actors are essential for maintaining connectivity and facilitating efficient information flow. Strategies to enhance network density and leverage these central actors could improve overall communication and collaboration within the Waste Bank Units.

Acknowledgments

The author would like to express deep gratitude to the Matsumoto Laboratory, Graduate Programs in Environmental Systems, Graduate School of Environmental Engineering, The University of Kitakyushu, Japan in support of the studies to be conducted effectively.

REFERENCES

- Borgatti, S.P., 2005. Centrality and network flow. *Social Networks* 27, 55–71.
- Capaian Kinerja Pengelolaan Sampah, n.d.
- chandra, wahyu, 2023. Makassar dan Masalah Darurat Sampah.
- CNN Indonesia, 2022. Sampah Plastik 2021 Naik ke 11.6 juta ton, KLHK Sindir Belanja Online. www.cnnindonesia.com.
- D'Andrea, A., Ferri, F., Grifoni, P., 2010. An Overview of Methods for Virtual Social Networks Analysis. In: Abraham, A., Hassanien, A.-E., Snáǵel, V. (Eds.), *Computational Social Network Analysis, Computer Communications and Networks*. Springer London, London, pp. 3–25.
- DeVito, J.A., 2012. *Human communication: the basic course, 12.ed., [intern. ed.]*. ed. Allyn & Bacon, Boston.



- Falcone, P.M., D'Alisa, G., Germani, A.R., Morone, P., 2020. When all seemed lost. A social network analysis of the waste-related environmental movement in Campania, Italy. *Political Geography* 77, 102114.
- Fatmawati, F., Mustari, N., Haerana, H., Niswaty, R., Abdillah, A., 2022. Waste Bank Policy Implementation through Collaborative Approach: Comparative Study—Makassar and Bantaeng, Indonesia. *Sustainability* 14, 7974.
- Gimnastiar, M.F., Yuwono, T., Marlina, N., n.d. Implementasi Collaborative Governance Dalam Pengelolaan Sampah Di Kelurahan Kalipancur, Kecamatan Ngaliyan, Kota Semarang (Bank Sampah Indria Jaya).
- Hongwei, Q., Xin, L., Xiteng, L., Yan, W., 2022. Research on communication efficiency of resident emergency knowledge embedded in social network. *China Safety Science Journal* 32 (8), 156–160.
- Juniyanti, L., n.d. Dinamika Kekuatan Aktor Dan Jaringan Sosial Dalam Perubahan Bentang Alam Provinsi Riau. Institut Pertanian Bogor (IPB).
- Kubota, R., Horita, M., Tasaki, T., 2020. Integration of community-based waste bank programs with the municipal solid-waste-management policy in Makassar, Indonesia. *J Mater Cycles Waste Manag* 22, 928–937.
- Lestari, aisyah putri, 2022. Potensi Peran Non State Actor (NSA) Sektor Pengelolaan Sampah dalam Mendorong Pembangunan Rendah Karbon dan Ekonomi Hijau di Indonesia.
- Luo, Q., Zhong, D., 2015. Using social network analysis to explain communication characteristics of travel-related electronic word-of-mouth on social networking sites. *Tourism Management* 46, 274–282.
- Malina, A.C., Muchtar, A., 2017. Kajian Lingkungan Tempat Pemilahan Sampah Di Kota Makassar. *Jurnal Inovasi dan Pelayanan Publik Makassar* 1.
- Pratama, B., 2020. Penerapan Tools Ucinet Untuk Social Network Analysis Guna Mendapatkan Pola Interaksi Manusia Pada Organisasi. Universitas Islam Indonesia, Yogyakarta.
- Prell, C., Hubacek, K., Reed, M., 2009a. Stakeholder Analysis and Social Network Analysis in Natural Resource Management. *Society & Natural Resources* 22, 501–518.
- Prell, C., Hubacek, K., Reed, M., 2009b. Stakeholder Analysis and Social Network Analysis in Natural Resource Management. *Society & Natural Resources* 22, 501–518.
- Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., Stringer, L.C., 2009. Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management* 90, 1933–1949.
- Rumambi, F.J., 2023. Environmental Effects on Health: The Role of Sustainable Environmental Management. *jika* 8.
- Saputri, M.M., Hanafi, I., Ulum, M.C., n.d. Evaluasi Dampak Kebijakan Pemerintah Daerah Dalam Pengelolaan Sampah Melalui Program Bank Sampah (Studi di Bank Sampah Sumber Rejeki Kelurahan Bandar Lor Kecamatan Mojojoto Kota Kediri). *Jurnal Administrasi Publik* 3 (11), 1804–1808.
- Setiawan, 2021. Membenahi Tata Kelola Sampah Nasional.
- Shehara, P.L.A.I., Siriwardana, C.S.A., Amaratunga, D., Haigh, R., 2019. Application of Social Network Analysis (SNA) to Identify Communication Network Associated with Multi-Hazard Early Warning (MHEW) in Sri Lanka. In: 2019 Moratuwa Engineering Research Conference (MERCon). Presented at the 2019 Moratuwa Engineering Research Conference (MERCon), IEEE, Moratuwa, Sri Lanka, pp. 141–146.
- Shehara, P.L.A.I., Siriwardana, C.S.A., Amaratunga, D., Haigh, R., 2019. Application of Social Network Analysis (SNA) to Identify Communication Network Associated with Multi-Hazard Early Warning (MHEW) in Sri Lanka. *Moratuwa Engineering Research Conference* 141–146.
- Siregar, N.I., Sadon, D., Wibowo, C.T., 2020. Analisis Jaringan Komunikasi Kelompok Tani Dalam Penerapan Budi Daya Padi Metode System Of Rice Intensification (Sri). *j. penelit. komun. dan pembang.* 21, 1.
- Sulistiawati, A., 2014. Analisis Jaringan Komunikasi Dan Evaluasi Jaringan Kepemimpinan Dalam Gabungan Kelompok Tani. Institut Pertanian Bogor, Bogor, Indonesia.
- Sutiawati, D.A., Abdullah, M.T., Yani, A.A., n.d. Analisis Dampak Program Bank Sampah Bagi Masyarakat Urban: Studi Kasus Di Kota Makassar. . p. 1.
- Utami, A.B., 2018. Analisis Jaringan Komunikasi Kelompok 1.



Volume 6 Nomor 3 December 2024

Journal of Public Administration and Government

journal homepage: <https://jurnal.fisip.untad.ac.id/index.php/JPAG>



-
- Uzzell, D., Moser, G., 2006. Environment and quality of life. *European Review of Applied Psychology* 56, 1–4.
- Wasserman, S., Faust, K., 1994. *Social network analysis: methods and applications, Structural analysis in the social sciences*. Cambridge University Press, Cambridge ; New York.
- Webster, C.M., Morrison, P.D., 2004. Network analysis in marketing. *Australasian Marketing Journal* 12, 8–18.