

Integrating Technology to Enhance Financial Sustainability of Waste Bank in Cilebut Timur

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ABSTRACT

Community-based waste banks play an important role in supporting environmental sustainability while creating economic value for local communities. However, many waste banks continue to face operational and financial challenges that limit their long-term sustainability. One such challenge is experienced by the Waste Bank of Kampung Ramah Lingkungan Berseri, RW 14, Cilebut Timur, Bogor Regency, Indonesia. The institution still relied on manual financial management and sold recyclable plastic waste without further processing, resulting in relatively low economic returns. This Community Service Program aimed to strengthen the sustainability of the waste bank through the integration of appropriate technology and digital financial literacy. The program consisted of providing a plastic shredding machine, technical training on machine operation and maintenance, and educational workshops on digital financial management, including digital bookkeeping, electronic payment systems, and digital investment awareness. The implementation adopted participatory approaches involving observation, needs assessment, training, mentoring, and evaluation. A total of thirty-nine participants consisting of waste bank administrators and community members participated in the activities. The results demonstrated improvements in participants' understanding of digital financial management, increased awareness of financial sustainability, and enhanced operational capacity through the utilization of plastic shredding technology. Furthermore, the intervention increased the economic value of recyclable plastic materials by enabling value-added processing before sale. These findings indicate that integrating appropriate technology with digital financial literacy contributes positively to strengthening waste bank sustainability while promoting community empowerment and supporting circular economy initiatives. Outputs generated from this activity include educational videos, scientific publications, mass media dissemination, and Intellectual Property Rights (IPR).

Keywords: *Appropriate Technology; Circular Economy; Digital Finance; Financial Literacy; Waste Bank Sustainability*

ABSTRAK

Bank sampah merupakan salah satu bentuk pemberdayaan masyarakat yang berperan penting dalam mendukung pelestarian lingkungan sekaligus meningkatkan nilai ekonomi limbah rumah tangga. Namun demikian, banyak bank sampah masih menghadapi berbagai kendala operasional dan pengelolaan keuangan yang menghambat keberlanjutan usahanya. Permasalahan tersebut juga dialami oleh Bank Sampah Kampung Ramah Lingkungan Berseri RW 14 Cilebut Timur, Kabupaten Bogor, yang masih melakukan pencatatan keuangan secara manual dan menjual limbah plastik tanpa proses pengolahan sehingga menghasilkan nilai jual yang relatif rendah. Kegiatan Pengabdian kepada Masyarakat ini bertujuan meningkatkan keberlanjutan bank sampah melalui penerapan teknologi tepat guna dan literasi keuangan digital. Program dilaksanakan melalui penyediaan mesin pencacah plastik, pelatihan pengoperasian dan perawatan mesin, serta edukasi mengenai pengelolaan keuangan digital yang meliputi pencatatan keuangan, penggunaan pembayaran digital, dan pengenalan investasi digital. Metode

pelaksanaan menggunakan pendekatan partisipatif melalui observasi, identifikasi kebutuhan, pelatihan, pendampingan, dan evaluasi. Sebanyak tiga puluh sembilan peserta yang terdiri atas pengurus bank sampah dan masyarakat mengikuti kegiatan ini. Hasil kegiatan menunjukkan adanya peningkatan pemahaman peserta mengenai pengelolaan keuangan digital, meningkatnya kesadaran terhadap pentingnya keberlanjutan keuangan, serta bertambahnya kapasitas operasional melalui pemanfaatan mesin pencacah plastik. Selain itu, kegiatan ini mampu meningkatkan nilai ekonomi limbah plastik karena plastik dapat diproses terlebih dahulu sebelum dipasarkan. Hasil tersebut menunjukkan bahwa integrasi teknologi tepat guna dan literasi keuangan digital mampu memperkuat keberlanjutan bank sampah sekaligus mendukung pemberdayaan masyarakat serta implementasi ekonomi sirkular. Luaran kegiatan meliputi video edukasi, publikasi ilmiah, publikasi media massa, serta Hak Kekayaan Intelektual (HKI).

Kata Kunci: Bank Sampah; Ekonomi Sirkular; Keberlanjutan; Keuangan Digital; Teknologi Tepat Guna

INTRODUCTION

Environmental degradation caused by the continuous increase in municipal solid waste has become one of the major challenges faced by both developed and developing countries. Rapid population growth, urbanization, industrial development, and changing consumption patterns have significantly increased the volume of household waste generated each year. According to the World Bank, global municipal solid waste generation is projected to continue increasing substantially unless more sustainable waste management systems are implemented (Kaza et al., 2018). Improper waste management contributes not only to environmental pollution but also to greenhouse gas emissions, declining public health, flooding, and the inefficient utilization of valuable recyclable resources. Consequently, sustainable waste management has become one of the key priorities in achieving the Sustainable Development Goals (SDGs), particularly Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production), and Goal 13 (Climate Action).

Indonesia faces similar challenges as one of the world's largest producers of municipal solid waste. The Ministry of Environment and Forestry (KLHK) reported that household waste continues to dominate national waste generation, with plastic waste remaining one of the largest contributors due to its high consumption and relatively low recycling rate. Plastic waste requires hundreds of years to decompose naturally and therefore poses serious environmental risks when not managed appropriately. In response to these challenges, the Government of Indonesia has promoted community-based waste management programs to encourage waste reduction at the source while simultaneously creating economic opportunities for local communities. One of the most successful community-based approaches is the establishment of Waste Banks (Bank Sampah), which integrate environmental conservation with community economic empowerment (Asteria & Heruman, 2016).

Waste banks function as community organizations that encourage households to separate recyclable materials before they are deposited and exchanged for monetary value. Beyond reducing the volume of waste transported to landfills, waste banks also improve environmental

awareness, strengthen community participation, and create additional household income. Therefore, waste banks have increasingly been recognized as an important instrument in implementing circular economy principles, where waste is no longer viewed as useless material but rather as an economic resource that can be processed, reused, and recycled into products with higher added value. The circular economy approach has received increasing global attention because it simultaneously addresses environmental sustainability and economic resilience through resource efficiency and waste minimization.

Although waste banks have demonstrated positive environmental and social impacts, many community-based waste management organizations continue to experience operational and financial sustainability challenges. Previous community empowerment programs have generally emphasized environmental awareness campaigns, waste sorting education, and recycling activities. However, relatively limited attention has been given to strengthening institutional sustainability through the integration of appropriate technology and financial management capacity. As a result, many waste banks remain highly dependent on voluntary participation, external assistance, and conventional operational systems, limiting their long-term effectiveness.

One of the major challenges frequently encountered by community-based waste banks is the relatively low economic value of recyclable materials. In many cases, plastic waste is sold directly without any further processing, resulting in lower market prices compared with shredded plastic materials that have undergone preliminary processing. Appropriate technology, therefore, plays an important role in increasing productivity, improving operational efficiency, and generating greater economic value from recyclable waste. Appropriate technology refers to technology that is simple, affordable, easy to maintain, and suitable for the needs and capacities of local communities. The adoption of plastic shredding machines enables waste banks to produce higher-value recyclable materials while reducing transportation volume and improving operational efficiency. Consequently, technology transfer has become an important strategy for strengthening community economic empowerment and supporting the implementation of circular economy practices.

Besides technological constraints, financial sustainability represents another critical issue affecting the long-term development of waste banks. Sustainable community organizations require sound financial management to ensure transparency, accountability, and efficient resource allocation. Nevertheless, financial administration within many waste banks is still conducted manually, making financial reporting less systematic and reducing managerial efficiency. Manual bookkeeping also limits organizational capacity to evaluate financial performance, prepare budgets, and support future business planning.

The rapid development of digital financial services provides new opportunities for community organizations to strengthen their financial governance. Digital finance encompasses various financial services delivered through electronic platforms, including mobile banking, electronic wallets, digital payments, online financial reporting, and financial technology (fintech) applications (Pazarbasioglu et al., 2020; Risman et al., 2021). The integration of digital finance into

community organizations contributes not only to transaction efficiency but also to financial inclusion, transparency, and organizational sustainability (Durai & Stella, 2019; Huda & Risman, 2024). Previous studies have demonstrated that financial inclusion supported by digital financial services improves financial decision-making, organizational resilience, and long-term economic welfare (Risman et al., 2021; Risman, 2024).

Financial literacy constitutes one of the key determinants influencing the successful adoption of digital financial services. Community members with adequate financial literacy tend to demonstrate better financial planning, improved saving behavior, and greater readiness to utilize financial technology in supporting productive economic activities. Conversely, limited financial literacy often causes community organizations to rely on conventional cash-based transactions and manual administrative systems, thereby reducing operational effectiveness. Accordingly, strengthening digital financial literacy has become increasingly important in supporting sustainable community-based economic institutions.

Kampung Ramah Lingkungan Berseri, RW 14, Cilebut Timur, Bogor Regency, established its Waste Bank as part of a community initiative to improve environmental quality while generating economic benefits from recyclable household waste. Despite its strong community participation, the Waste Bank still encountered several strategic constraints that affected its sustainability. First, recyclable plastic waste was sold directly without prior processing because the organization did not possess a plastic shredding machine. Consequently, recyclable materials generated relatively low selling prices, limiting institutional revenue. Second, financial administration remained entirely manual, reducing efficiency, transparency, and accountability in financial management. Third, the administrators had limited knowledge regarding digital financial services that could support bookkeeping, digital transactions, and financial planning. These conditions indicate that the sustainability challenges faced by the Waste Bank extend beyond environmental management and require integrated interventions addressing both operational productivity and financial governance.

Based on the situational analysis conducted prior to the implementation of the Community Service Program, it was identified that strengthening waste bank sustainability requires an integrated approach combining appropriate technology with digital financial literacy. Unlike previous community service initiatives that primarily focused on environmental education or waste management campaigns, this program combines technology transfer through the provision of a plastic shredding machine with capacity building in digital financial management. This integrated approach is expected to generate complementary impacts by simultaneously increasing the economic value of recyclable waste and strengthening institutional financial management. Such integration represents the main contribution of this Community Service Program toward supporting sustainable community empowerment and advancing circular economy implementation at the local level.

Therefore, Universitas Mercu Buana, in collaboration with Universiti Sains Malaysia, implemented an International Joint Community Service Program aimed at enhancing the sustainability of the Waste Bank in Kampung Ramah Lingkungan Berseri through the application

of appropriate technology and digital financial literacy. Specifically, this program sought to (1) improve the operational productivity of the Waste Bank through the provision and utilization of a plastic shredding machine; (2) strengthen participants' knowledge and skills regarding digital financial management; (3) improve financial governance and operational sustainability of the Waste Bank; and (4) contribute to strengthening community empowerment through environmentally and economically sustainable waste management practices.

METODE

This Community Service Program adopted a participatory empowerment approach, involving active collaboration between the Community Service Team and the Waste Bank administrators throughout the implementation process. The program was conducted at the Waste Bank of Kampung Ramah Lingkungan Berseri (KRL) RW 14, Cilebut Timur, Bogor Regency, with 39 participants consisting of Waste Bank administrators, community representatives, and local residents.

The implementation consisted of five main stages: (1) preliminary observation and needs assessment, (2) program planning, (3) technology transfer through the provision of a plastic shredding machine, (4) digital financial literacy education, and (5) monitoring and evaluation. The overall implementation process is presented in Figure 1.

During the preliminary stage, field observations and discussions were conducted to identify the operational conditions and challenges faced by the Waste Bank. The assessment indicated two major issues: the absence of a plastic shredding machine, resulting in low economic value of recyclable plastic waste, and limited digital financial literacy among administrators, leading to manual financial management.

Based on these findings, the Community Service Team implemented two integrated interventions. The first intervention involved the provision of a plastic shredding machine accompanied by practical training on machine operation, maintenance, and occupational safety. The second intervention consisted of digital financial literacy education covering financial inclusion, digital payment systems, digital bookkeeping, financial planning, and financial transaction security. The educational activities were delivered through lectures, discussions, demonstrations, and interactive question-and-answer sessions.

Program evaluation was conducted using participant questionnaires and direct observations during the activities. The evaluation measured participants' satisfaction, perceived usefulness of the program, and their understanding of the materials delivered. The collected data were analyzed descriptively using percentage distributions to evaluate the effectiveness of the Community Service Program.

COMMUNITY EMPOWERMENT PROGRAM SCHEME: PLASTIC RECYCLING



Figure 1. Steps for Implementing Activities

(Source: Processed by the Author, 2026)

RESULTS AND DISCUSSION

The Community Service Program was successfully implemented at Kampung Ramah Lingkungan Berseri (KRL) Berseri RW 14, Cilebut Timur, Bogor Regency. The activity involved 39 participants consisting of Waste Bank administrators, community members, lecturers, students from Universitas Mercu Buana, and collaborators from Universiti Sains Malaysia. The opening session introduced the objectives of the program and emphasized the importance of integrating environmental sustainability with digital financial literacy to strengthen the sustainability of community-based waste management organizations.



Figure 2. Community Service Program Participants at KRL Berseri RW 14

(Source: Author's Documentation, 2026)

The participatory approach adopted throughout the program encouraged active engagement between facilitators and participants. Community members were given opportunities to share their experiences in managing household waste, operating the Waste Bank, and addressing challenges encountered in financial administration. Such interaction enabled the facilitators to deliver solutions that were relevant to the actual needs of the community. Active community participation is considered an essential element in community empowerment because it strengthens participants' sense of ownership and increases the sustainability of program outcomes. Similar findings have been reported by Asteria and Heruman (2016), who emphasized that the success of Waste Bank programs largely depends on active community involvement and institutional capacity.

Digital financial literacy education constituted one of the core components of the Community Service Program. The educational session focused on improving participants' understanding of financial literacy as an essential component of sustainable Waste Bank management. The materials covered financial inclusion, digital payment systems, digital bookkeeping, financial planning, transaction security, and the utilization of digital financial applications to support community-based organizations.

The educational sessions were delivered through interactive lectures, discussions, and question-and-answer activities, enabling participants to share their experiences and challenges in managing Waste Bank finances. During the discussion session, several participants acknowledged that financial administration was still conducted manually and that the utilization of digital financial services remained limited. These findings are consistent with the needs assessment conducted prior to program implementation.

Interactive discussions also demonstrated participants' enthusiasm for adopting digital financial applications to improve transparency, accountability, and operational efficiency. Previous studies suggest that improving digital financial literacy contributes to better financial decision-making, greater financial inclusion, and improved organizational sustainability (Pazarbasioglu et al., 2020; Durai & Stella, 2019; Risman et al., 2021). Therefore, strengthening financial literacy among Waste Bank administrators is expected to enhance financial governance while supporting long-term institutional development

One of the principal outputs of the Community Service Program was the provision of a plastic shredding machine as an appropriate technology intervention for the Waste Bank. The equipment was introduced to improve the processing of recyclable plastic waste before being sold to recycling industries.



Figure 3. Plastic Shredding Machine Provided to the Waste Bank

(Source: Author's Documentation, 2026)

Prior to the intervention, recyclable plastic waste was generally sold without further processing, resulting in relatively low economic value. Through the utilization of the plastic shredding machine, plastic waste can now be processed into shredded plastic, which possesses higher market value and lower transportation costs due to reduced volume. In addition to equipment handover, the Community Service Team provided practical training on machine operation, occupational safety, routine maintenance, and troubleshooting to ensure that participants are able to operate the equipment independently.

The provision of appropriate technology represents an important strategy for increasing productivity while strengthening the economic sustainability of community-based waste management organizations. Rather than functioning solely as production equipment, the plastic shredding machine enables the Waste Bank to create added value from recyclable materials

before marketing them to recycling industries. This intervention supports the implementation of circular economy principles, in which waste is treated as a valuable resource that can be reprocessed to generate economic, environmental, and social benefits. Similar studies have reported that the adoption of appropriate technology significantly improves the operational performance and financial sustainability of community-based waste management institutions.

The effectiveness of the Community Service Program was evaluated using questionnaires distributed to all participants after the implementation of the activities. The evaluation focused on measuring participants' competencies related to plastic waste processing, digital financial literacy, business management, and their readiness to implement the knowledge and technology introduced during the program. Overall, the results indicate that the program successfully improved participants' knowledge, practical skills, and motivation to further develop sustainable waste bank activities.

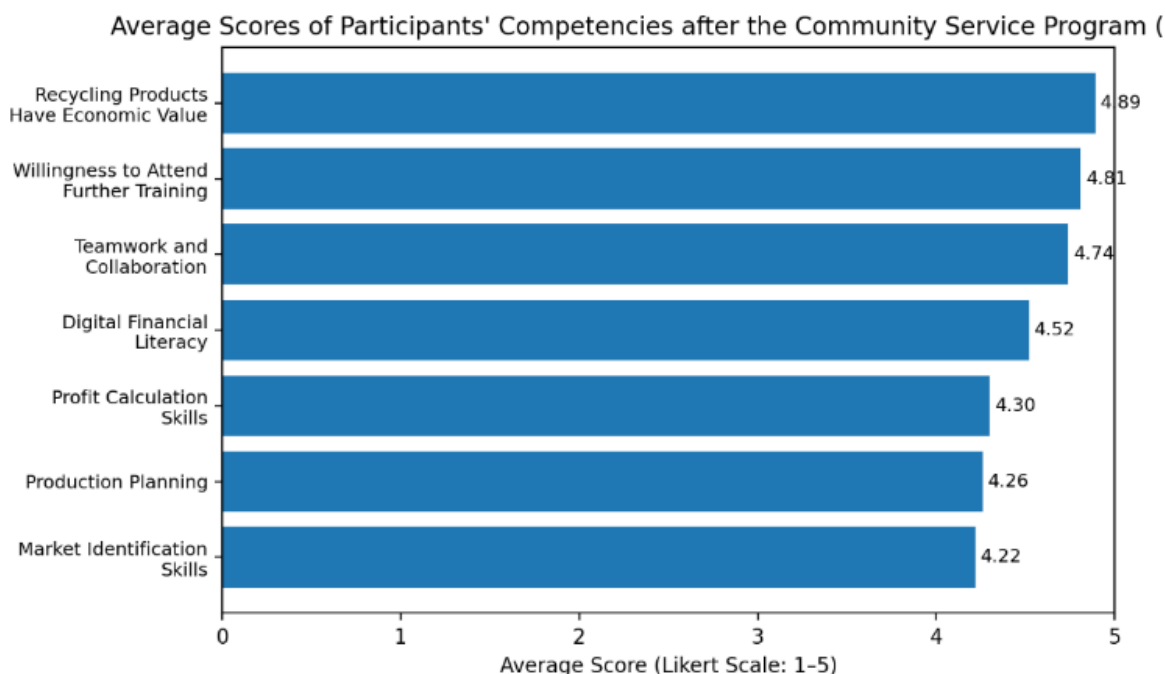


Figure 4. Average Scores of Participants' Competencies after the Community Service Program
(Source: Processed by the Author, 2026)

The evaluation results show that understanding the economic value of recycled products achieved the highest average score (4.89), followed by willingness to participate in further training (4.81) and teamwork and collaboration (4.74). These findings indicate that the program successfully increased participants' awareness of the economic potential of recyclable waste while encouraging continuous learning and strengthening collaborative engagement among Waste Bank members.

The indicator of digital financial literacy obtained an average score of 4.52, indicating that participants demonstrated a good understanding of the application of digital financial services in Waste Bank management. Nevertheless, relatively lower scores were observed for market identification skills (4.22), production planning (4.26), and profit calculation skills (4.30). These results suggest that although participants acquired fundamental knowledge of digital financial management and plastic waste processing, additional mentoring is still required to strengthen entrepreneurial competencies, particularly in marketing strategies, production planning, and business profitability analysis. These specific topics proved more challenging as they demand advanced analytical thinking and a deeper understanding of market dynamics, which are often unfamiliar to community members accustomed to conventional, direct waste transactions. Future mentoring programs should address this gap by incorporating hands-on business simulations, providing simplified financial calculation templates, and establishing strategic partnerships with local recycling industries to transform these abstract business concepts into practical daily operations.

Overall, all competency indicators obtained average scores above 4.20 on a five-point Likert scale, demonstrating a high level of participant acceptance and understanding of both the digital financial literacy training and the appropriate technology introduced during the program. These findings indicate that integrating technology transfer with capacity-building activities can effectively improve the technical and managerial competencies required to support sustainable community-based waste management.

Table 1. Evaluation of the Community Service Program Implementation Results

Before the Community Service Activity	After the Community Service Activity
Waste bank members manually processed plastic waste, resulting in low productivity and limited recycling capacity.	Waste bank members are able to process plastic waste more efficiently using the plastic shredding machine, increasing productivity and improving the quality of recyclable materials.
Most participants had limited knowledge of digital financial literacy and digital financial management.	Participants have a better understanding of digital financial literacy, including digital payment systems, digital bookkeeping, and basic financial management.
Financial records were still maintained manually, making it difficult to monitor income, expenses, and business performance.	Participants are able to apply simple digital financial management practices to record transactions and monitor the financial performance of the waste bank.
Participants had limited understanding of the economic value of recycled plastic products and business development opportunities.	Participants recognize the economic potential of recycled plastic products and are more prepared to develop sustainable waste bank businesses.

Waste bank operations relied primarily on conventional management practices with limited technological support.	The integration of appropriate technology and digital financial literacy has strengthened operational efficiency and improved the financial sustainability of the waste bank.
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The comparison presented in Table 1 demonstrates substantial improvements in both technical and managerial capacities following the implementation of the Community Service Program. The introduction of the plastic shredding machine significantly enhanced the efficiency of plastic waste processing and increased the economic value of recyclable materials. At the same time, digital financial literacy education improved participants' understanding of digital payment systems, financial record management, and basic financial planning. The integration of appropriate technology and financial capacity building therefore provided complementary benefits that strengthened the operational performance and long-term sustainability of the Waste Bank.

CONCLUSION AND SUGGESTION

CONCLUSION

The Community Service Program conducted at Kampung Ramah Lingkungan (KRL) Berseri RW 14, Cilebut Timur, Bogor Regency, successfully enhanced the capacity of the Waste Bank through the integration of appropriate technology and digital financial literacy education. The provision of a plastic shredding machine improved the efficiency of plastic waste processing and increased the economic value of recyclable materials, while digital financial literacy training strengthened participants' understanding of financial inclusion, digital payment systems, digital bookkeeping, and basic financial management.

The program evaluation demonstrated positive outcomes, as reflected by the high average competency scores across all evaluation indicators. Participants showed improved awareness of the economic potential of recyclable waste, stronger teamwork, increased willingness to participate in future training, and better understanding of digital financial management. These findings indicate that combining technology transfer with capacity-building activities is an effective strategy for strengthening the operational and financial sustainability of community-based waste management organizations.

Overall, the Community Service Program has contributed to improving community empowerment by enhancing technical skills, managerial capacity, and institutional sustainability of the Waste Bank. The integrated approach adopted in this program may serve as a practical model for similar community empowerment initiatives aimed at supporting sustainable waste management and promoting circular economy practices.

SUGGESTION

To ensure the long-term sustainability of the program, continuous mentoring and periodic evaluation are recommended to support the implementation of digital financial management and the optimal utilization of the plastic shredding machine. Future community service programs should also expand collaboration with local governments, recycling industries, financial institutions, and other relevant stakeholders to strengthen market access, improve business development, and increase the economic value of recycled products. Furthermore, additional training in entrepreneurship, product marketing, and digital business management is recommended to enhance the competitiveness and self-reliance of Waste Bank communities.

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REFERENCES

- Asteria, D., & Heruman, H. (2016). Bank sampah sebagai alternatif strategi pengelolaan sampah berbasis masyarakat di Tasikmalaya. *Jurnal Manusia dan Lingkungan*, 23(1), 136–141. <https://doi.org/10.22146/jml.18783>
- Durai, T., & Stella, G. (2019). Digital finance and its impact on financial inclusion. *Journal of Emerging Technologies and Innovative Research*, 6(1), 122–127.
- Huda, N., & Risman, A. (2024). The behavioral finance of MSMEs: Financial inclusion and financial technology (case study on MSMEs in West Jakarta). *Jurnal Ilmiah Manajemen & Bisnis*, 8(2), 19–29.
- Kaza, S. Y. L. C., Yao, L. C., Bhada-Tata, P., & Van Woerden, F. (2018). What a waste 2.0: a global snapshot of solid waste management to 2050. 2018. Washington DC.
- Organisation for Economic Co-operation and Development. (2022). OECD/INFE toolkit for measuring financial literacy and financial inclusion 2022. OECD Publishing.
- Pazarbasioglu, C., Garcia Mora, A., Uttamchandani, M., Natarajan, H., Feyen, E., & Saal, M. (2020). Digital financial services. World Bank Group.
- Risman, A. (2024). The behavioral finance of MSME: Digital finance, managerial biases, financial literacy. *Dinasti International Journal of Economics, Finance & Accounting*, 5(2), 641–649. <https://doi.org/10.38035/dijefa.v5i2.2660>
- Risman, A., Ali, A. J., Soelton, M., & Siswanti, I. (2023). The behavioral finance of MSMEs in the advancement of financial inclusion and financial technology (FinTech). *The Indonesian Accounting Review*, 13(1), 91–101. <https://doi.org/10.14414/tiar.v13i1.3213>

- Risman, A., & Mustaffa, M. (2023). Literasi keuangan bagi UMKM: Laporan keuangan untuk pengembangan usaha UMKM. Jurnal Abdimas Perbanas, 4(1), 20–27.
<https://doi.org/10.56174/jap.v4i1.521>
- Risman, A., & Saputra, B. L. E. (2023). Literasi keuangan bank sampah: Emas digital untuk mengatasi penurunan nilai poin DTBM dan saldo kas. Jurnal Abdimas Perbanas, 4(2), 59–66.
<https://doi.org/10.56174/jap.v4i2.533>