CHAPTER V
CONCLUSION AND SUGGESTION

5.1 Conclusion

Based on the results of this study, several key conclusions can be drawn as follows:

1. The current state of municipal solid waste management in Padang City presents both significant challenges and promising opportunities. The city generates approximately 660.06 tons of waste daily, a volume on an upward trend that creates pressure on existing landfill capacity. Coming from questionnaire results, a large proportion of this waste showed that specifically 38.0% organic and 43.0% mixed organic/plastic is identified as highly suitable for anaerobic digestion (AD) due to its high biodegradable content. Public sentiment towards Waste-to-Energy (WtE) technologies is overwhelmingly positive, with 99.0% of respondents believing in waste's energy potential and 77.0% approving of WtE facility construction. However, major hurdles include the low practice of waste segregation, as 54.0% of residents reported never segregating their waste, and a significant lack of awareness regarding AD technology (68.0% unaware). The prevailing waste management method involves centralized collection and landfill disposal, often without prior separation, which limits the efficiency of resource recovery.
2. Analysis of the waste's composition provides crucial insights into its suitability for AD. Proximate analysis revealed that food waste has a moisture content of 24.48%, while plastics show a significantly lower moisture content at 0.10%. Plastic also exhibited the highest volatile matter at 90.12%, indicating a high concentration of organic compounds, though not all are biodegradable for AD. Ultimate analysis, which determines elemental composition, showed that paper waste is rich in Oxygen (51.01%) and Carbon (35.22%), wood is predominantly Carbon (44.08%), and food waste has the highest Oxygen content (76.69%) among the analyzed samples. Rubber, notably, contains the highest Carbon content (71.91%) and Hydrogen (10.69%) among the tested samples.
3. The theoretical biogas yield, calculated using the Buswell equation, highlights the varying potential of different waste components. Among the individual waste

samples analyzed, rubber showed the highest theoretical methane potential at 4.23 mol CH_4/mol sample, followed by wood (2.23 mol CH_4/mol sample), paper (1.28 mol CH_4/mol sample), and food waste (0.09 mol CH_4/mol sample). When converted to volume, rubber again yielded the highest at 1073.33 mL/g of CH_4, followed by wood (626.86 mL/g), paper (313.88 mL/g), and food waste (21.78 mL/g). These results indicate that while rubber possesses a high theoretical methane yield, its practical application in AD would be significantly dependent on its actual biodegradability content. Overall, considering both theoretical potential and practical feasibility, biodegradable organic wastes, particularly food waste, are identified as the most suitable components for anaerobic digestion in Padang City due to their high organic content, which are essential for efficient biogas production.

4. A preliminary implementation plan for the Limau Manis area proposes a community-scale Anaerobic Digestion (AD) system. This system would specifically target the segregated organic fraction of municipal solid waste to produce renewable electricity, aiming to foster localized energy independence. A crucial aspect of this plan is the establishment of an effective source separation system, which would involve distributing separate bins to households and setting up dedicated collection routes for organic waste. The biogas generated from the AD process, primarily methane, would then be fed into a Combined Heat and Power (CHP) unit to produce electricity, which could either supplement the local grid or directly power community facilities. Beyond energy generation, the plan emphasizes the importance of digestate management; the nutrient-rich byproduct could be processed into biofertilizer, thereby promoting a circular economy. However, the successful implementation of this plan faces several challenges, including the existing low practice of waste segregation, limited public awareness of AD, mixed willingness among residents to pay for waste-derived electricity, and the practical considerations of land availability and pre-treatment infrastructure. Addressing these challenges through targeted educational campaigns, tangible incentives for segregation, diverse funding mechanisms, and transparent economic models will be critical for the project's success and sustainability.

5.2 Suggestion

To further advance the potential of AD in Padang City, future research should focus on several key areas.

1. There is a need to optimize AD processes specifically for the unique characteristics of Padang City's municipal solid waste, including exploring effective pre-treatment methods for materials like wood and paper to maximize biogas yield.
2. Comprehensive techno-economic analyses and sustainable business models for community-scale AD systems should be developed, considering local market conditions and potential revenue streams from both electricity generation and the sale of biofertilizer.
3. Research should investigate effective strategies for fostering long-term behavioral change in waste segregation and explore the factors influencing residents' willingness to pay for waste-derived electricity.
4. It is crucial to conduct thorough environmental impact assessments of proposed AD facilities, evaluating their contribution to greenhouse gas emission reductions and any potential impacts on local ecosystems.