Final Project on "PETman: A Tech-Enabled Social Business Model for Tackling Bangladesh's Plastic Waste Crisis"

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Final Project on "PETman: A Tech-Enabled Social Business Model for Tackling Bangladesh's Plastic Waste Crisis"

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Letter of Transmittal

November 8, 2025

Md Kamruzzaman Didar
Assistant Professor & Head
Head, Department of Innovation & Entrepreneurship
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Subject: **Submission of Final Project on "PETman: A Tech-Enabled Social Business Model for Tackling Bangladesh's Plastic Waste Crisis"**

Dear Sir,
It is my great pleasure to submit the report named **"PETman: A Tech-Enabled Social Business Model for Tackling Bangladesh's Plastic Waste Crisis"** as a part of Project Implementation of the Department of Innovation & Entrepreneurship for your kind consideration. I made sincere efforts to "PETman: A Tech-Enabled Social Business Model for Tackling Bangladesh's Plastic Waste Crisis" and examined relevant records for the preparation of the report.

Within a limited time, I have worked to make this report as comprehensive as possible. But there may be some incompleteness due to various restrictions. For this reason, I beg your kind consideration in this regard.

Sincerely Yours,

Bayezid Chowdhury
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Declaration of Student

I, Bayezid Chowdhury, Student ID: 221-45-037, 21th Batch, Department of Innovation & Entrepreneurship, Daffodil International University, hereby declare that the project report entitled: "PETman: A Tech-Enabled Social Business Model for Tackling Bangladesh's Plastic Waste Crisis"

This project report represents my personal work which I completed during my final year of study at university. The research project emerged from academic work which took place within the Daffodil International University. The report exists in its original form because it has never been submitted to any other academic program or institution for any type of evaluation or recognition. The report's findings together with its analyses remain unpublished in any academic journals or commercial magazines or any other outside publication sources.

The report contains all references and secondary sources which I have cited to the best of my knowledge.

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Certificate of Approval

This is to certify that Bayezid Chowdhury, Student ID: 221-45-037 , a dedicated student in the Department of Innovation & Entrepreneurship at the Faculty of Business and Entrepreneurship, Daffodil International University, has successfully completed his final year project on **"PETman: A Tech-Enabled Social Business Model for Tackling Bangladesh's Plastic Waste Crisis"**

After thoroughly reviewing the report, I can confidently say it presents a well-rounded study on strategies for business growth and sustainability. The work showcases originality, practical insights, and meets the academic standards we uphold.

I am pleased to approve this project report as part of the requirements for the undergraduate degree.

Md Kamruzzaman Didar
Assistant Professor & Head
Head, Department of Innovation & Entrepreneurship
Daffodil International University

Acknowledgement

In the very first place, I would like to thanks to my Almighty Allah for granting me the strength, patience, and willpower to complete this project. I would also like to offer my deep appreciation to my respected supervisor, Md Kamruzzaman Didar, Head of the Department of Innovation & Entrepreneurship at Daffodil International University. His unwavering guidance, valuable advice, and tireless encouragement have been instrumental in shaping this report. His guidance has truly been a pillar of my academic journey. I also appreciate all the members of the Department of Innovation & Entrepreneurship for their insightful lessons and for giving the intellectual infrastructure that made it possible to conduct this work.

Special thanks are given to my peers and fellow classmates for their cooperation, healthy argumentation, and encouragement throughout the research process. Their suggestions and advice played a key role in informing this project.

Finally, I want to acknowledge the steadfast support of my family and friends. Their encouragement and inspiration have given me the confidence to successfully navigate this academic journey.

Abstract

Each morning, the Dhaka city is awakened by an old but unstoppable issue of plastic waste overflowing out of the drainage systems, blockages of the canals, and floating in the overcrowded streets. Today Bangladesh produces almost 1700 tons of plastic waste daily, and in Dhaka alone, over 6,500 tonnes of waste is generated, and very little of this waste is actually recycled. What trickles down flows into rivers, exacerbates urban flooding, contributes to the emergence of a slow-burning crisis of the emission of greenhouse gases and the destruction of nature (World Bank, 2021; Haque, 2022).

Amid this commotion, there is a silent set of laborers going around alleys and dumping areas. They are the informal rubbish collectors referred to as tokai or kabadiwallas in the neighborhood. They sort, pick and gather plastics discarded by other people with a single bag on their shoulders. Their labor is highly valued to the recycling economy yet no one can observe them. They earn some cash here and there and are exploited by middle men and made to bear the stigma of society.

PETman was conceived at the intersection of a social outcast and an environmental crisis. PETman is not only a recycling center. It aims to become a social business as a result of which recycling plastic in Bangladesh will become easier and more technologically scrupulous. PETman connects households, informal collectors, recyclers, businesses, and NGOs with a mobile-based business that allows the process of disposing of trash to be more transparent, followable, and respectful. Correct recycling by households results in rewards, improved routes and higher income by collectors, and verified CSR and ESG data by businesses. PETman is not just another waste application that uses its profits to scale its impact. This is in accordance with the vision of social business developed by Professor Muhammad Yunus (2007; 2010; 2017) and the 3ZERO model (zero poverty, zero unemployment, and zero net carbon emissions).

To pilot this vision, a six-month test was done in Dhaka involving 120 households, 30 collectors and 3 corporate partners. Information was collected through surveys, logs of the platform, semi structured interviews, and observations. The figures were quite eloquent: the household recycling participation increase was almost twofold, as it was 35 percent before and 70 percent after. Rewards like vouchers and credits were significant in encouraging the behavior change and the contamination of recyclables reduced as families started sorting PET bottles more attentively.

Income of collectors increased by approximately 40 percent (approximately 300 BDT to approximately 420 BDT a day) due to increased efficiency in the routes. It is even more important that many of them claimed that their jobs helped them to feel more stable and dignified. It was also valuable to corporate partners, with two out of the three companies indicating an interest in scaling up due to the dashboards of ESG compliance offered by PETman being so reliable.

PETman is superior compared to other platforms. International initiatives such as Recycle Bank or Kabadiwalla Connect do not consider informal collectors or merely scan the households. The strong point of PETman is that it unites all stakeholders into a single ecosystem.

Naturally, constraints were also divulged by the pilot. It did not do any more detailed analysis of Dhaka and only data of six months were available. Others continued to experience the problem of smartphone illiteracy. In order to grow PETman larger, it will have to relocate it to additional cities, explore its long-term impact, and obtain the assistance of policymakers. The comparison of countries might also enhance the model and establish it as a reference to the Global South countries with similar issues.

But PETman demonstrates that technology and social business can become mutually complimentary when it comes to dealing with long-standing problems. The platform also contributes to a number of the Sustainable Development Goals (SDGs) of the United Nations, including SDG 11 (Sustainable Cities), SDG 12 (Responsible Consumption), SDG 13 (Climate Action), and SDG 8 (Decent Work). It is not only a local movement, but it belongs to a global movement of sustainable living which adheres to the 3ZERO system.

To summarize, the story of PETman does not only focus on plastic; it also focuses on people, respect, and how innovation can unite environmental responsibility and social justice. It demonstrates that an entire city, or perhaps even a nation, can be actually headed in the right direction in terms of a cleaner and a more just future when garbage is turned into something and hidden workers are made respected and discover

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Chapter 1 — Introduction

Plastic is everywhere you go in Bangladesh in busy streets, on canals, and heaps on roadside corners. It has found its way into the life of the people so silently, in grocery bags and even water bottles, yet its afterlife is a very dark tale. The cities of Bangladesh generate approximately 23000 tonnes of solid waste daily and approximately 1700 tonnes of it is plastic. The capital of the nation, Dhaka, produces 6,500 tonnes of waste per day, and barely any of it is ever recycled (World Bank, 2021; Haque, 2022). The remaining plugs drains, leads to flash floods during rainy seasons, contaminates rivers, and emits greenhouse gasses which make a convenience a curse on the environment.

Nowhere in the background of this crisis is a greater force to be seen than the invisible hands of the informal recycling workforce. The ones who actually make the chain of recycling in Bangladesh are the tokai and kabadiwallas children and adults who pass their days rummaging in bins and landfills. The very plastic, which returns to the market, is gathered, sorted and sold to them. However, on the one hand, they are not visible: they work under hazardous conditions, receive volatile wages, and are deprived of respect in the society where their role is hardly ever recognized (Hoque and Clarke, 2020). This ensures that plastic pollution is not only an environmental issue but a very social and economical issue as well.

PETman is in this reality not only a digital platform, but a mission-driven social business. PETman will consolidate households, businesses, recyclers, and, most significantly, informal waste gatherers into a single transparent and trustworthy system. It is not just convenient through the use of mobile technology, behavioural incentives, and inclusive entrepreneurship. In contrast to other waste applications that perceiving waste management as far as logistics or household collection, PETman places the collectors, who are often overlooked in the limelight, providing them with formal recognition, consistent incomes, and livelihoods that are safer.

It has straightforward but radical objectives:

- To reduce plastic pollution through rewarding disposal and recycling.
- To instill power in informal collectors by making invisible work dignified.

- To give companies and NGOs actionable CSR and ESG data, so that they can be held accountable and not symbolically.

In this paper, the authors consider the example of the pilot of PETman in Dhaka with the following questions which were developed with the sense of urgency: Is it possible to change the household behavior towards responsible recycling with the help of incentives? Do informal collectors have their lives raised by formal inclusion? Does sustainable data allow corporates and non-governmental organizations to go beyond meaningless sustainability speeches? Last but not least, what is the difference between PETman and local/global waste management innovations?

In its essence, PETman represents the ethos of the social business philosophy of Professor Yunus (2007; 2010; 2017) showing that people and planet should be considered jointly as the solution to contemporary crises. PETman can not only clean up the city of Bangladesh but also give Bangladesh a chance to rewrite the waste story into the story of opportunity, dignity and resilience by being aligned to the global 3ZERO vision zero poverty, zero unemployment, zero net carbon emissions PETman.

Table 1. Solid Waste and Plastic Waste in Bangladesh (Selected Sources)

Indicator	**Value / Estimate**	**Source**
Total daily solid waste (Bangladesh)	~23,000 tonnes	World Bank (2021)
Daily waste generated in Dhaka	~6,500 tonnes	World Bank (2021)
Estimated plastic waste share	~1,700 tonnes/day	Haque (2022)
Recycling rate (plastic)	~36% (mostly informal)	Hoque & Clarke (2020)
Informal waste workers in Dhaka	200,000+ (est.)	NGO estimates

Chapter 2 — Literature Review

2.1 Social Business and the 3ZERO Vision

In the first instance when Muhammad Yunus had thought of the concept of social business, he was essentially asking us to question the purpose of business. Another idea that he had was not to build companies but to solve them either poverty, unemployment or environmental degradation and still be able to stand on their own feet financially (Yunus, 2007; Yunus, 2010). Making profit is not the goal in this approach. It is a device, a means of keeping the work on. And rather than giving out the earnings in form of dividends, they are reinvested into the mission to reach more people. This belongs to his greater two-point zero dream: zero poverty, zero unemployment, and zero net carbon emission (Yunus, 2017).

PETman is an effort to make such a dream come true. It is not simply concerning the gathering of plastic bottles or the decrease of waste. It is of the people who do this each and every day waste collectors who are typically neglected and undercompensated. PETman provides them with dignity, stable earnings, and appreciation of the contribution they make in ensuring that our environment is clean. Meanwhile, it addresses one of the largest environmental problems that we address today plastic pollution. That is, PETman attempts to address two issues simultaneously constructing livelihoods and restoring the planet.

2.2 Inclusive Entrepreneurship and Bottom-of-the-Pyramid (BoP) Marketing

Inclusive entrepreneurship aims at providing space to the underprivileged groups in market systems by allowing them to have dignity as well as economic empowerment (Prahalad, 2005). People are also usually perceived as consumers of cheap products at the Base of the Pyramid (BoP). However, in reality, they have massive potential to be active producers and problem-solvers and add value to economic ecosystems. PETman does not overlook this point of view. It changes their status of being invisible individuals working at the fringe of the society and transforms them into stakeholders with actual power by providing them with digital tools, practical training, and fair payment systems. This does not only enhance livelihoods but it also creates a more inclusive and sustainable entrepreneurial prototype.

2.3 Digital Tools in Waste Management

Technology in most countries has begun to transform the collection of waste. In U.S. as an example, Recycle Bank will award points to households based on their recycling efforts, which are redeemed in form of rewards. Kabadiwalla Connect in India assists informal waste collectors in getting their waste collected to buyers, and makes their work more organised and well remunerated.

The same cannot be said about Bangladesh. The majority of digital solutions are small projects which only target the convenience at home. Others that are excluded include the kabadiwallas and informal recyclers who go out and collect and sort garbage on the streets. Reliable data that can be used to monitor the waste is practically unavailable to the companies and this makes the entire system inefficient.

2.4 Comparative Positioning of PETman

PETman does not operate in the same manner as other sites. It links the homes, businesses and informal collectors of waste together. The workers who are not in formal employment have a chance to receive reasonable compensation and decent monitoring of their labour, and the corporations can know where their garbage is going. PETman does not leave anyone behind as compared to the other apps that only assist households.

Besides, PETman is established as a social enterprise. The profits are reinvested into the system to enhance worker tools as well as reach more areas. In this manner, it does not only manage garbage that it assists informal employees to earn their livelihood and motivates additional citizens to engage in recycling.

Figure 1. Comparative Positioning of PETman vs Other Waste-Management Platforms

(1 = Present, 0 = Absent)

Features	Existing Apps in Bangladesh	International Platforms	PETman
Household Convenience	01	01	01
Incentives for Citizens	00	01	01
Integration of Informal Collectors	00	00	01
Traceability / CSR Reporting	00	01	01
Financial Sustainability (Social Business)	00	00	01

As illustrated in the chart, the PETman is the only model which has integrated household convenience, incentives, informal worker integration, traceability and social-business financial model. This makes PETman a social business which is scalable in the Global South and also a technological innovation.

Chapter 3 — Methodology

3.1 Research Design

This research used a convergent mixed-methodology, which involved quantitative monitoring of recycling activities and changes in income as well as including qualitative interviews and field observations. This design was aimed at capturing the measurable impacts as well as lived experiences to be able to evaluate the operational feasibility, social inclusion and market acceptance of the model of PETman.

3.2 Pilot Setting and Duration

The pilot was carried out in more than half a year in a few selected areas within Dhaka, Bangladesh. The city was selected as it is considered the epicenter of the waste-management crisis in the country as it produces around 6,500 tones of waste per day (World Bank, 2021), as well as the largest group of informal waste collectors.

3.3 Participants

There were three main stakeholder groups that the pilot involved:

- **Households (n=120):** Registered users of the PETman mobile application, which includes middle-income and upper-middle-income segment, in Dhaka.
- **Informal Waste Collectors (n=30):** Persons who will be hired and trained to utilize PETman digital tools to have an optimization of routes and direct sales of materials.
- **Corporate Partners (n=3):** Companies that incorporated the CSR dashboards of PETman to monitor and record their recycling activities.

3.4 Data Collection Instruments

The instruments to be used in the collection of data will be as follows:

- **Platform Logs:** Automated data on scheduled pickups, material types, weights picked up and route performance.
- **Household Surveys:** Pre and post piloting surveys of recycling behavior, awareness and satisfaction (n=120).
- **Collector Surveys:** Baseline and endline survey based on income level, number of working hours, commuting time, and sense of dignity (n=30).
- **Semi-Structured Interviews:** 25 household participants, 20 waste collectors and 10 corporate CSR managers were interviewed.
- **Field Observations:** On-site observation of the collection processes and awareness campaigns of the neighborhood.

3.5 Data Analysis

- **Quantitative Analysis:** Descriptive statistics of the degrees of participation, recycling volumes, and changes of income.

- **Qualitative Analysis:** Thematic coding of the interviews to find out the repeated patterns (e.g., empowerment, convenience, fairness, transparency).

- **Comparative Benchmarking:** Examination of features of other online platforms in Bangladesh and other countries to position the specific contribution of PETman**.**
- **Comparative Benchmarking:** Review of features from other digital platforms in Bangladesh and globally to contextualize PETman’s distinct contributions.

3.6 Limitations

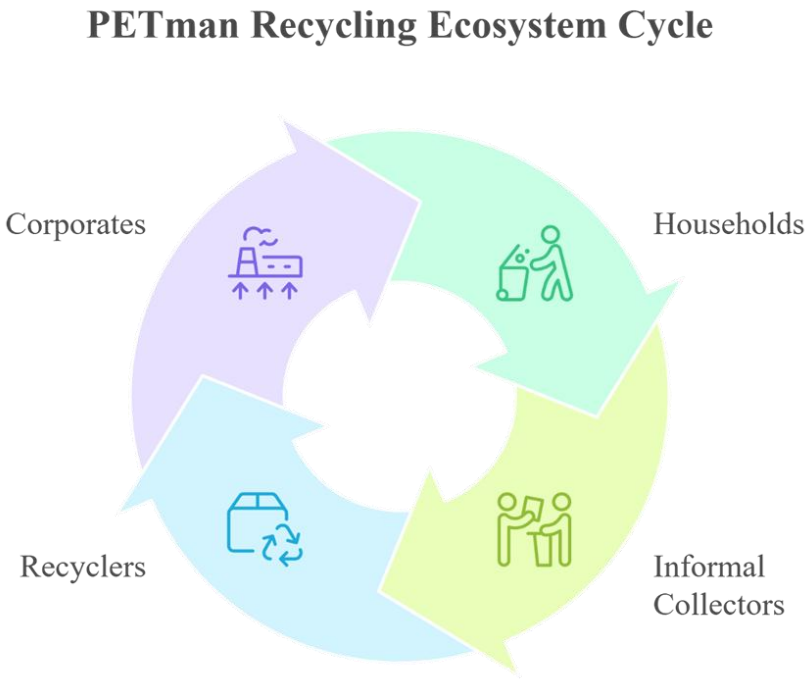
- Pilot limited to urban areas of Dhaka, results might not be applicable in the rural setting.
- Six-month period precludes long-term behavioral change.
- The size of the sample was small enough to reach some insights of exploration but not causal.
- Reliance on smartphone literacy locked out some prospective users.

Table 2. Summary of Pilot Participants

Stakeholder Group	Number (n)	Description
Households	120	Registered PETman app users (middle- and upper-middle-income Dhaka residents)
Informal Waste Collectors	30	Recruited, trained, and equipped with smartphones for optimized collections
Corporate Partners	03	Firms testing PETman's CSR dashboards and reporting functions
Household Interviews	25	Semi-structured, focusing on recycling behavior and app usability
Collector Interviews	20	Semi-structured, focusing on income, dignity, and work efficiency
Corporate Interviews	10	Semi-structured, focusing on CSR value and transparency

Chapter 4—Findings

The pilot of the PETman produced knowledge in three major stakeholder segments, including households, informal waste collectors, and corporate partners. The outcomes also show the quantifiable changes as well as the qualitative impressions of dignity, convenience, and accountability.



4.1 Household Participation and Behavioral Change

The second major effect of the PETman pilot was the growth in the household recycling. A survey conducted at the baseline showed that only about 35 percent of the households usually separated PET bottles to recycle them. In the six-month pilot, the participation had increased almost by half to 70%.

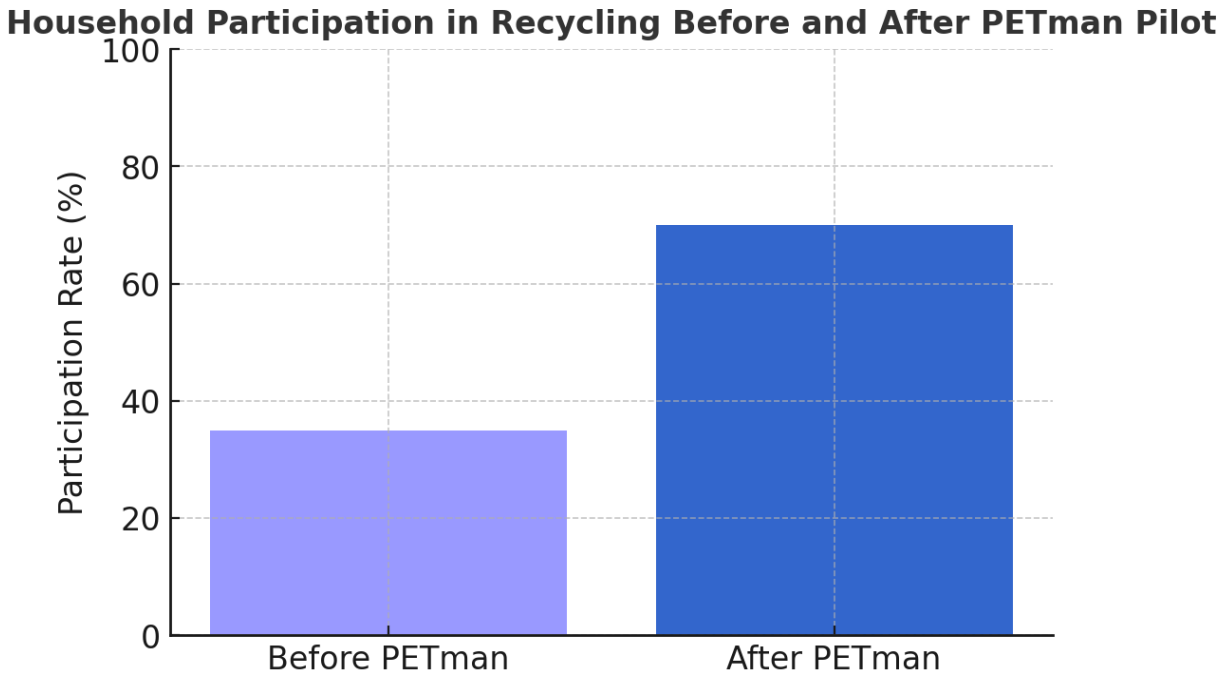
- **Participation Increase:** The recycling participation increased between the baseline (approximately 35 percent) and post pilot (approximately 70 percent), which is a 30 to 40 percentage point increase.

- **Motives to Change:** Convenience (scheduled pickups) and incentive (small monetary credits and vouchers) were listed by the households as the motivation factors. Weaker results had been previously only achieved through awareness campaigns.
- **Convenience:** Scheduled pickups minimized the effort involved during the recycling process and this overcame a significant behavioral obstacle.
- **Recycling Quality**: The contamination of the recyclables was reduced because households noted that they were more careful about PET bottles sorting, as the collection was incentivized.

A change of perception was found through qualitative interviews. One participant noted:

Earlier on I used to dispose bottles with the rest of the garbage. Now, having PETman I feel I am doing something bigger. Even my children say to me to keep bottles apart.

Figure 2. Household Participation in Recycling Before and After PETman Pilot



4.2 Collector Livelihoods and Empowerment

The decision of PEPTman to incorporate the informal waste collectors into a formal system had an immense effect on the livelihoods of the informal waste collectors. The daily income rose by about 40 BDT; the average daily income rose by about 420 BDT, which is about 40 percent. To a large extent, this was enhanced by:

- Optimization of routes, which lessened the time spent without work, and allowed the collectors to pay more households within the same hours.
- Eliminating exploitative intermediaries: selling to recycling partners directly.

In addition to the financial profits, the quality interviews also brought out increased social dignity and stability. Collectors were appreciative of the fact that they have become part of an organized system. One collector explained:

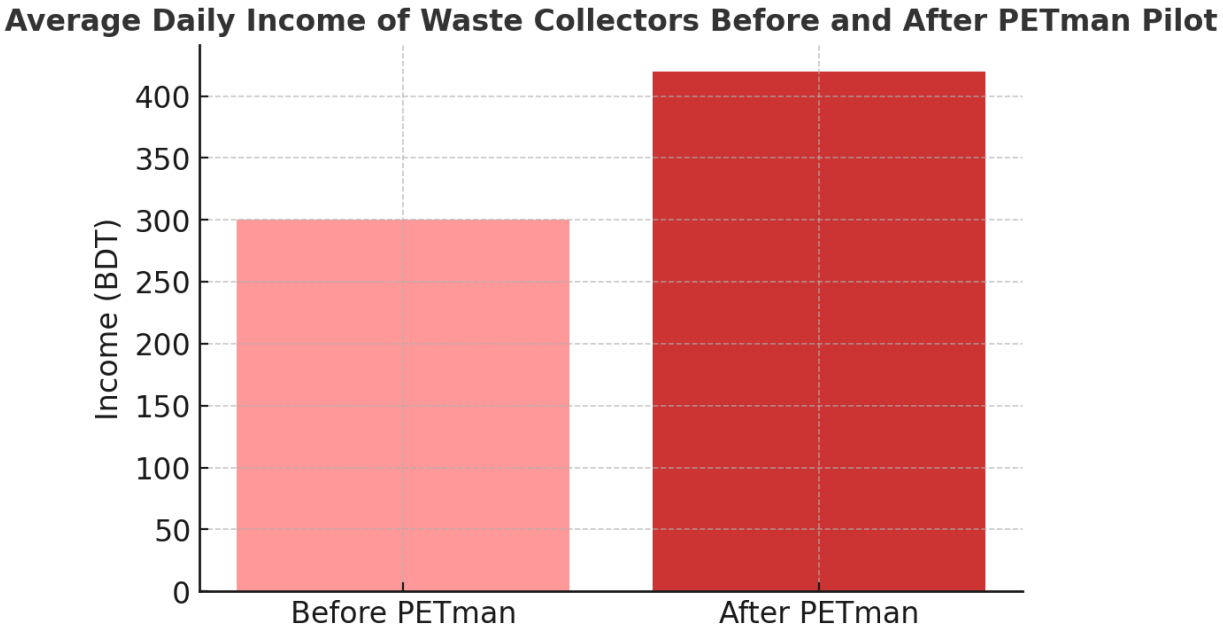
"Prior to PETman, I would walk the entire day and I could still have no idea as to how much I would be making. Now, I do not have a schedule, work less and earn more. When it becomes apparent to people that I belong to PETman, they respect me more."

→ **Income Effect:** Daily income growth in terms of average is between 300 and 420 BDT (approximately 40 percent).

→ **Operational Efficiency:** Route optimization minimized idle travel time allowing collectors to serve more households with less waste time.

→ **Social Outcomes:** According to the interviewed collectors, dignity and predictability of earnings were higher. According to one of the participants, using PETman, I am in control of how much I will earn by the end of the week, and not just by chance.

Figure 3. Average Daily Income of Waste Collectors Before and After PETman Pilot



4.3 Corporate Engagement and CSR/ESG Reporting

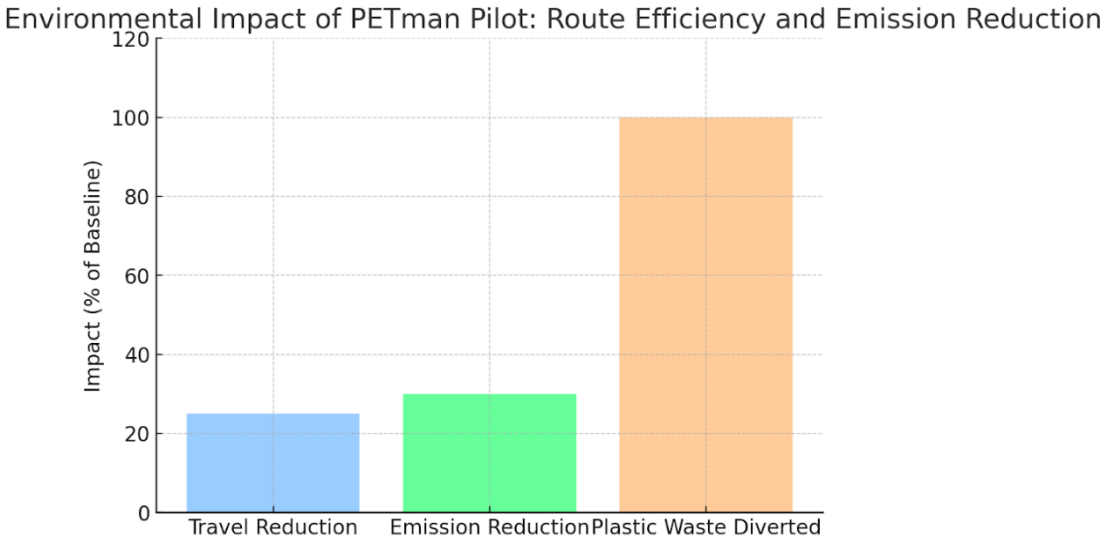
All three corporate partners were involved with the CSR dashboard of PETman in the pilot. These dashboards offered verifiable information on the contribution of recycling such as the type and mass of plastics diverted out of landfills. This was noted as a great improvement to the earlier CSR initiatives which in most cases lacked transparency as reported by corporate managers.

Two companies showed tangible interest in the extension of their partnership on top of the pilot, connecting PETman data to the global ESG reporting standards. The third had been in the evaluation phase but had identified the prospects of reputational and compliance gain.

It shows that PETman can be a powerful B2B service and will provide corporates with auditable data on environmental impact and at the same time, help the informal workers be socially included.

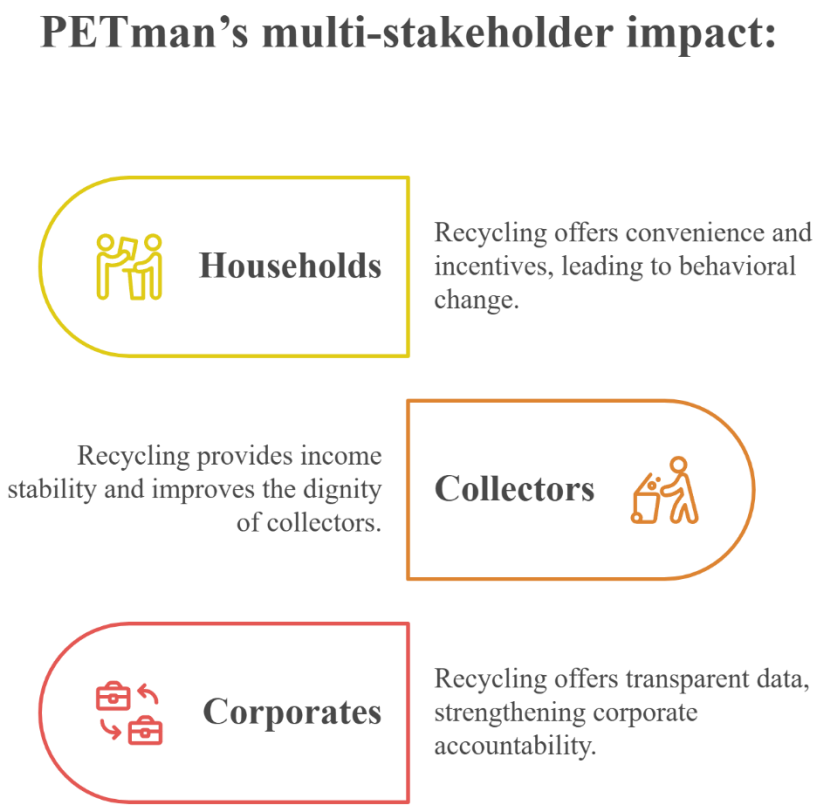
- **Usage of Dashboard:** The three corporate partners were found to be highly satisfied with the CSR dashboards of PETman that delivered verifiable data and volumes of recycling.
- **Value to Transparency:** Corporates emphasized that they were able to report auditable, traceable metrics as a significant enhancement to the old CSR programs.
- **Future Adoption:** Two of the firms were interested in the extension of the collaboration beyond the pilot stage and connecting PETman data with the overall ESG reporting needs.

4.4 Environmental Outcomes and Operational Efficiency



- **Material Diversion:** Pilot records showed that the plastic waste was being diverted out of landfills into confirmed recycling streams.
- **Traceability:** PETman app recorded type, weight, and source of collection of the pick-up assuring a transparent set of data.
- **System Efficiency:** Route optimization, the travel time per collector was lower by an average of 2530, which saved money and reduced emissions.

The findings demonstrate PETman's **multi-stakeholder impact**:



Although the environmental benefits of the lifecycle of a pilot were not estimated accurate, in this pilot, estimated figures indicate that at scale, PETman could considerably decrease urban plastic leakage and help Bangladesh to adhere to SDGs.

Chapter 5 — Discussion

The PETman pilot shows that a technology-based social enterprise can be both environmentally sustainable, inclusive in its business, and accountable in its corporation in Bangladesh. In this section, the findings are interpreted in theoretical and comparative terms and implications on policy and practice identified.

5.1 Social Business and the 3ZERO Vision

PETman realizes the idea of social business of Muhammad Yunus, who puts the main goal in addressing the social and environmental issues and ensuring financial sustainability (Yunus, 2007; 2010). The design of the pilot, to reinvest revenues on the recyclable sales and CSR partnerships in the scaling operations is an indication of non-dividend, impact-first orientation of social business. PETman will impact the 3ZERO vision of Yunus which is zero poverty, zero unemployment, and zero net carbon by alleviating poverty and economic insecurity among waste collectors, offering them dignified employment opportunities, and reducing plastic pollution (Yunus, 2017).

The direct involvement of the informal waste collectors correlates with the vision of 3ZERO proposed by Yunus:

- **Zero Poverty:** PETman increases the economic security by improving the daily incomes of the collectors and decreasing the reliance on the middleman.
- **Zero Unemployment:** PETman provides a clean cut job in a marginalized sector of labour by institutionalizing the waste collectors.
- **Zero Net Carbon:** PETman will cut down carbon emission in waste that is not being managed in landfills and reduces carbon emission through poor routes.

The results reinforce the idea that social businesses can act as **practical vehicles for SDG achievement**, particularly:

- **SDG 11 (Sustainable Cities and Communities**): waste recycling centers.
- **SDG 12 (Responsible Consumption and Production):** motivating the circular practices.
- **SDG 13 (Climate Action):** reduction of landfill emissions by landfill diversion.
- **SDG 8 (Decent Work and Economic Growth):** empowering and informalizing informal workers**.**

5.2 Inclusive Entrepreneurship and Bottom-of-the-Pyramid Marketing

The pilot discusses the fact that strategies of inclusive entrepreneurship can generate quantifiable benefits to marginalized actors. Income growth of 20-40 percent and less reliance on exploitative middlemen was attained in waste collectors, typically excluded in formal systems. The example of this empowerment is a BoP marketing, which implies creating services that might be available and useful to low-income populations (Prahalad, 2005).

PETman makes them micro entrepreneurs by supplying the collectors with smartphones, route optimization and direct connection to the recycling markets. This transcends token inclusion and marginalized actors are part and parcel of the circular economy. This change has a symbolic and material aspect:

- Symbolically, it gives dignity and legitimacy.
- On a material level, it increases the incomes and regularizes working habits.

Unlike tokenistic CSR programs where marginalized groups of people are usually seen as passive recipients of the value created, PETman involves them in value co- creation. This would be in line with the constructs of inclusive market structures that focus on the role of ensuring the inclusion of vulnerable groups in the mainstream economies (London and Hart, 2011).

5.3 Comparative Positioning: PETman vs Other Platforms

A major contribution of PETman lies in its comparative distinctiveness.

- **Bangladesh-based digital-apps:** Most do not incorporate structural integration of informal workers nor verified data for corporates, and focus heavily on convenience in the household with waste pick-up services. PETman takes it one step ahead by contemplating needs of home, collectors and corporates all at the same time.
- **International platforms:** Recycle Bank (USA) rewards participation by household; Kabadiwalla Connect (India) acts as an intermediary between informal aggregators and larger recycling companies. But these are organised on commercial logics or on a reliance of donors. PETman is a non-dividend, social business which ensures mission linkage and the re-investment of funds for scale-up.
- **Innovation point:** PETman is the first approach where in a bottom-top way, citizen incentive, informal worker empowerment, corporate CSR traceability and financial sustainability change can seen together. This alignment is an unusual cocktail and is unique solution-oriented opportunity for addressing ecological, social and institutional aspects of the plastic waste problem.

Three differences separate PETman from other e-waste management systems in Bangladesh:

- **Stakeholder Engagement:** Contrary to proprietary apps which are focused around convenience in the household, PETman's solution consolidates households, collectors, recyclers, corporates and NGOs under one system.
- **Traceable and Accountable:** Unlike many other regional initiatives, PETman's CSR dashboards account for (and make it possible to verify) (auditable record) of data used in corporate ESG reporting.
- **Social Business Orientation:** International examples such as Recycle Bank (USA) and Kabadiwalla Connect (India) do help with logistics and incentives however are driven by predominantly commercial logics.) On the other hand, PETman reinvests in mission expansion and follows a non-dividend mission-first system (Yunus, Moingeon and Lehmann-Ortega,2010).

5.4 Policy Implications

The pilot findings have implications for policy in a number of directions:

- **Informal Workers' Recognition:** PETman has demonstrated that informal collectors bring quantifiable benefit both environmental and economic, when part of formal system. Policymakers should accept them as legitimate stakeholders in municipal waste management, a group to which we intend issuing ID cards, safety gear and social protections.
- **Digital Inclusion Assistance:** Hurdles to access smart phone and digital literacy are high. Government and nonprofit partnerships could subsidize devices, offer training, and lower the costs of connectivity so that more people participate in tech-based systems.
- **Corporate incentives:** Governments can incentivise corporate partners by making tax rebates or CSR commitments conditional on measurable recycling through platforms such as PETman.
- **Integration with Circular Economy Policy:** The traceability tools developed by PETman place it in a good position to feed into both national and international circular economy frameworks. Its model is amenable for formal inclusion in SDG tracking and climate action policy, with the potential to deliver scalable metrics of progress.

5.5 Academic Contributions

Apart from theory and practice, PETman has a number of implications on the academic plane with respect to social business and sustainability:

- It shows how technology can enhance Yunus's social business model through transparency, efficiency, and scale.
- It informs BoP marketing debates, showing that marginalized consumers can be empowered not just as consumers, but also as producers and entrepreneurs.
- It contributes to the increasing literature on circular economy transitions in the Global South, and underscores the importance of integrating informal systems with formal digital platforms.

Chapter 6—Limitations and Future Research

6.1 Limitations of the Study

Although the pilot PETman provided encouraging outcomes, a number of constraints should be mentioned:

1. **Pilot Scale and Generalizability:** The experiment was carried out on 120 households, 30 waste gatherers and 3 corporate partners and mainly in urban Dhaka. This will be very useful in exploratory evidence, but the sample is small and confined to a limited area, which restricts the extrapolation of the results to other cities or rural settings in Bangladesh.

2. **Limited Pilot Period:** There was a short duration of piloting of six months which limited the capacity of measuring the long-term behavioral change of households and the long-term economic consequences to the waste collectors. Seasonal differences in production and recycling of wastes were not reflected.

3. **Selection Bias:** It is possible that Households that accepted taking part in the pilot could already be more environmentally conscious or technologically savvy and will therefore introduce a bias in the results toward more favourable ones.

4. **Digital Divide:** PETman is based on smartphone-based engagement. Those collectors that not only lacked digital experience before but also needed substantial training and not all low-income households were included. This poses a threat of strengthening prevailing inequalities unless dealt with in scaling strategies.

5. **Data Limitations:** Although platform logs were more detailed in the form of quantitative data, the qualitative information of the interviews was as per the self-reporting of the participants which is susceptible to social desirability bias.While the PETman pilot generated promising results, several limitations must be noted:

6.2 Future Research Directions

To address these limitations and expand the academic contribution, future research should:

1. **Scale-Up Trials:** Implement larger pilots in a number of Bangladeshi cities (e.g., Chittagong, Khulna, Sylhet) and urban/peri-urban/rural settings to assess adaptability across different socio-economic conditions.

2. **Longitudinal Analysis:** Extend pilot for 12–24 months to measure longer-term trends in household recycling and collector livelihoods, corporate engagement, as well as seasonal waste production.

3. **Experimental Methods:** Use RCTs or quasi-experimental designs to assess the causal effect of PETman interventions (e.g. alternative incentive structures, digital training modules).

4. **Comparative Works:** comparing PETman to other local and international waste management systems to better understand it's strengths and weaknesses. This also involves examining best practices at global level concerning circular economy models.

5. **Digital Inclusion Research:** Explore the pathways to overcoming smart phone access, digital literacy and gender differences among collectors as well as households.

6. **Policy Impact Assessment:** Investigate the formal linkage of PETman's CSR dashboards and traceability systems to government policies, tax benefits or SDG monitoring mechanisms.

Chapter 7 — Conclusion

This research assessed PETman as a social business innovation addressing plastic waste management in Bangladesh and the economic stagnation of informal waste collectors. In the context of a six-month pilot with 120 households, 30 collectors and 3 corporate partners in Dhaka, PETman showed its impact could be tangible in terms of environmental performance as well social gains and corporate accountability.

The results of the study showed three primary contributions:

- **Environmental impact:** Participation in household recycling increased by almost double (from 35% to 70%) and contamination of output recyclables was reduced through better sorting. The traceability system of PETman transparently recorded the waste plastics being diverted from landfill to recycling process.

- **Social and economic inclusion:** Waste pickers increased their daily average income by 40%. they also found that this gave them more dignity in their work, as well as that it was a stable job. By enabling marginalized actors with digital technologies and integrating them into formal systems, PETman promotes inclusive entrepreneurship and bottom-of-the-pyramid empowerment.

- **Corporate Accountability:** PETman's CSR dashboards provided corporate partners with the ability to monitor and validate their recycling contributions, thereby increasing transparency and meeting growing ESG and SDG reporting needs.

However, PETman differs from these and other local Bangladeshi and international waste-management centers in that it integrates citizen incentives, corporate traceability and informal workers under one roof with vests tailored towards incentivizing all parties to achieve optimal separation of recyclable. This approach of integration allows PETman to be interpreted as a scalable and transferable response for the Global South where waste emergencies, informal work, and weak mechanisms of accountability converge.

The limitations of the study, which include a relatively small sample limited to urban areas and short follow-up duration, highlight the importance of broader, longitudinal, comparative research. However, there is the potential for pilot results to inform both practices as well as theory by illustrating how Yunus's (2017) 3ZERO concept can be enacted and implemented into practice via digital innovation. PETman is fighting poverty -through decent job, unemployment- empowering informal workers and environmental sustainability from reduction of plastic pollution to circular economy.

Therefore, PETman demonstrates the opportunities for tech-based social enterprises to connect environmental sustainability, inclusive enterprise and corporate accountability. It is also relevant for a host of other SBAC 2025 tracks: Environment, Marketing & Entrepreneurship, Finance and the SDGs and Technology & AI. By expanding and perfecting this model, Bangladesh can not only solve its own urgent plastic crisis but also offer an exportable invention into the world conversation about social business and sustainable development.

Chapter 8 —References

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