

Perspectives.

Issue No. 43

**Solutions to social and
environmental impacts
of disposable diaper
waste in Vanuatu**





Executive Summary

The Tumble Drum is a hand-powered washing machine designed by Engineers Without Borders Australia (EWB Australia) to provide a sustainable, easy alternative to wash cloth diapers for rural communities in Vanuatu.

While this project began as an effort to reduce women's domestic workload in response to a government ban on disposable diapers, and to ease the health impacts of laundry washing, it has expanded into a mechanism for providing new livelihoods to marginalised women through sustainable sanitation.

Through intensive community consultation and technology prototyping, EWB Australia has piloted the concept of a laundry business using the Tumble Drum in a rural village in Efate Province, and is now supporting community members to explore operating such businesses, and finding ways that this new technology can challenge the stereotype of laundry washing as a feminine duty. This work also presents a potential solution to a problem that is experienced throughout the Pacific region.

Disclaimer

A United Nations Environment Programme (UNEP) publication series that presents views from major groups and stakeholders of civil society or about issues that are relevant for them.

PERSPECTIVES is coordinated by UNEP's Civil Society Unit. The presented views are entirely those of the authors and do not necessarily reflect the views of UNEP.

Contact address

Civil Society Unit
Governance Affairs Office
United Nations Environment
Programme (UNEP)
unep-civilsociety@un.org

[https://www.unenvironment.org/
civil-society-engagement](https://www.unenvironment.org/civil-society-engagement)

April 2023

Cover Photo:
© EWB Australia

Introduction

Global estimates on the number of single-use disposable diapers used for one baby range from 4,000 to 7,000, with each diaper reported to take nearly 500 years to decompose. As they do so, they pollute soil and waterways. Further decomposition of diapers creates smaller “microplastic” pieces that can be eaten by fish and end up being consumed by other species along the food chain, including humans. This waste also generates unhealthy levels of bacteria through the baby excreta (Miller-Wilson, 2021; Dyer, 2005; Khoo et al., 2019).

The transition to a more convenient lifestyle over the last 70 years has seen a dramatic increase in single-use plastic items across the globe (UNEP, 2018, pp. vi, 6). Included in these items are single-use disposable diapers. Although convenient in their use, the post-use disposal of solid waste can be difficult to manage and has significant impacts on the environment (Notten et al., 2021).

The Pacific region has not been excluded from the increasing presence of single-use disposable diapers. An estimated 815,500,000 single-use disposable diapers are used by families in the Pacific every year (SPREP, 2022), resulting in approximately 173,000 tonnes of waste that is disposed of in landfills, incinerated or discarded in the environment.

The Secretariat of the Pacific Regional Environment Programme (SPREP) commissioned EWB Australia to lead a research project, funded through the European Union’s PacWastePlus Programme. They found that more than half of the Pacific region’s population (59%) use disposable diapers all the time. Use of single-use disposable diapers is slightly higher in urban areas. The most common way to discard single-use disposable diapers is through authorised waste collection in urban areas, while rural areas rely on burying, disposal in pit latrines and burning.

Three Pacific countries (Kiribati, Tuvalu and Vanuatu) have implemented import controls to assist with the management of single-use disposable diapers – the only known measures of their kind in the world. The need to contain and manage baby excreta to reduce public health risks is well understood, and reusable diapers are seen as one potential solution.

But intersecting needs are at play, such as economic growth, equality and inclusion in today’s Pacific societies. These include the impact of solutions on women: as the primary caregivers, it is essential to understand how replacing disposable diapers with reusable diapers might impact their ability to enter the workforce and have the opportunity to contribute to



Figure 1: Disposable diapers are discarded in a pit in rural Vanuatu . © EWB Australia

community activities. An environment that can support behaviour change also needed to be explored, and appropriate technology artefacts also form part of this project.

Diaper mythbusting

In understanding the risks and benefits of single-use disposable diapers versus reusable diapers in the Pacific, the SPREP report (SPREP, 2022) investigated existing perceptions of women community members. This research uncovered some common misconceptions:

- *Single-use disposable diapers stay dry on a baby for longer.* While generally true compared to washable nappies options, this practice may impact the health and development of babies, their ability to balance and walk, and can result in urinary tract and other infections.
- *Burning is a good way to remove the waste.* Burning of excreta and plastic diapers emit dioxins, toxic fumes that have health impacts.
- *Reusable nappies are too expensive.* Given the low income of community members, reusable nappies were seen to have a high upfront cost, however, reusable nappies can represent a saving of at least US\$1,377 over three years.
- *Reusable nappies will limit the ability to work.* They are seen as hard to clean and dry and take more time to use than single-use disposable diapers. There is also an all or nothing mindset – “If I use reusable diapers, I will have to use them all the time.”
- *Eco-friendly, compostable diapers are good for the environment.* Some diapers claiming to be eco-friendly, 100% biodegradable or compostable do not degrade or compost naturally in the environment. They require specialist infrastructure such as controlled high temperatures and microbial composting facilities. The research found that biodegradability or composability claims are geared for consumer appeal, to make them appear unique and different from other brands, so are largely misleading. Some brands do not provide evidence of their claims and most brands focus on the eco-friendly claims of one aspect of their product, rather than the product as a whole.

The case in Vanuatu

In 2019, an attempt to ban disposable diapers in Vanuatu was postponed, due to insufficient support for any alternative. This decision provided the catalyst to better understand disposable diaper use and explore appropriate alternatives and supporting environments. Engineers Without Borders Australia has a local team based in Port Vila, Vanuatu, and has been working

with Ni-Vanuatu communities for four years to support water and sanitation solutions, so is well positioned to investigate alternatives. EWB Australia started with research with Ni-Vanuatu communities in Pango, Eratop and Eton villages. These communities were chosen due to their existing use and awareness of reusable diapers from a previous pilot project run by Mama’s Laef, a local washable nappies manufacturer.

Using a mixed method approach, data was collected from households with babies, as well as from active community members and stakeholders who play vital roles in community development (such as business owners, members of the area council, church leaders and village chiefs). More than half of the household interview participants (66%) were women aged 21 to 30 years, as women primarily stay at home or run a shop from their home as they look after their babies.

This research investigated current handwashing (laundry) needs and practices, the current use of reusable nappies, interest in adapting to new technology and perceptions on switching to reusable nappies. These views provided valuable insights into alternative ways to address disposable nappy waste.

The research data shows that all surveyed households were still using disposable nappies in some way, despite having access to locally made, reusable nappies. The average number of nappies used per child in a household was 4.4 per day, costing between US\$0.80 to more than US\$21.20 per month. In urban areas, disposable diapers were disposed of in bins maintained by waste collection services. In rural areas, diapers were buried in a pit, burned or thrown into the bush.

Reusable nappy practice in Vanuatu

Washable cloth nappies have been trialled in Vanuatu with mixed results. Mama’s Laef is a local social enterprise that supports the livelihoods of local Ni-Vanuatu women who produce reusable cloth nappies to sell to local communities. The organisation has been driving these trials.

In surveying households that have been part of the Mama’s Laef trial for reusable nappy use, 45 *85% of households surveyed were using these reusable nappies, and, before washing, were disposing of excreta in toilets or occasionally into a small drain next to an outdoor washing area (EWB, 2022). Others disposed of nappy waste into a bush or buried waste in a pit. Most of the households in Eton reported disposing waste in the toilet. This may be due to Eton primarily using ventilated-improved pit latrines, instead of flush toilets. Respondents that used buckets for washing reusable nappies reported that it took 20 to 40 litres of water per

wash.

However, 15% of surveyed households were having a challenging time switching to reusable nappies due to various social, economic and environmental barriers. Some mothers explained that they found reusable nappies time-consuming to change regularly when their workloads were busy or when travelling to town, church or other small distances. Many stopped using reusable nappies to save time and energy, for health reasons, or because of the inconvenience attributed to their design, the upfront cost of the diapers, the inconvenience of carrying soiled diapers in public, and the extra washing and drying work associated with the reusable diaper. It was found that almost one third of households who were finding it too challenging to make the switch had never used them.



Figure 2: Local Vanuatu social enterprise Mama's Laef has been producing reusable cloth nappies. © EWB Australia

When asked about their opinion on reusable diapers, stakeholders expressed it as a great way forward, especially if the country is moving towards a plastics ban. However, greater awareness is needed to educate households about the use of reusable diapers and the effect of them on the environment.

Handwashing in Vanuatu is the most common laundry practice. More than half of respondents (59%) washed laundry approximately 2 times per week, spending 1 to 2 hours and US\$1.70 to US\$8.50 per month on laundry

detergent. Families in rural areas don't have access to water or electricity to own a washing machine. Buying a washing machine is also very expensive and usually only affordable for people who live in urban settings. Even then, buying a washing machine may not be considered a priority. Many reported back pain as a major issue associated with hand washing, followed by cold and flu. Some also reported skin irritation, sinus issues, pelvic pain and bleeding.

One of the many challenges in adopting reusable diapers was connected to washing the diapers, specifically concerns about the time it takes, and the water and energy power needed. There would be challenges in mandating households to only use reusable diapers. With communities motivated to change the practice of environmentally unfriendly disposable diaper use, there was a need to identify solutions to make reusable nappies easier to use and more affordable. Enter the Tumble Drum Project.

The Tumble Drum Project

To create a supportive environment for higher interest and increased adoption of reusable diapers in Vanuatu, EWB Australia has been co-designing a washing machine with Ni-Vanuatu communities, using appropriate technology principles. The washing machine aims to reduce the workload required by mothers to handwash cloth diapers. Crucial to the design is that the technology must:

- be non-electric, acknowledging the many communities that have no or limited access to reliable electricity supply, and
- consider water use, as communities have variable access to clean water, and differing water types (salt versus freshwater).

Focus group discussions were conducted to gain a deeper understanding of women's laundry washing practices and any barriers, or enablers, to using or accepting the Tumble Drum – a hand-powered washing machine. Understanding that washing machine units were unaffordable at the household level, an alternative solution is also being explored: a community laundry service. Community laundry services are not common in Vanuatu and it is largely an unfamiliar concept. Key to testing this solution was exploring community perceptions of this idea; it would only be an effective solution if there was community interest and acceptance of the concept.

Addressing gendered norms

In Vanuatu, women have long been associated with household laundry responsibilities. If there was a reason

that a woman was unable to conduct laundry duties – due to disability, sickness or financial constraints – other family members not aware of the woman’s limitations would conclude that she was lazy, such are the expectations of a woman in a household.

One focus group revealed that the idea of using a Tumble Drum as a business was a contentious topic due to generational differences about the expectations of women to undertake all household chores. Discussions were also had on how diaper laundering may impact on a woman’s ability to fulfill all of her other domestic and caring responsibilities – choosing this line of business could create extra demands on women who already have financial and social constraints.

Older focus group participants expressed concern that a woman delegating another woman to do her laundry would bring gossip and family conflict. Generational gaps also suggested that the Tumble Drum may be best explored as a business option amongst the youngest cohorts of women in the communities. Younger participants in the research were more willing to explore a laundry business, especially to earn extra income, and some might be more keen than others to challenge gendered community attitudes towards housework.

In exploring if the Tumble Drum might encourage more men to wash clothes, two participants strongly answered that it would – the Tumble Drum is seen as a novel piece of technology to overcome the association between women and washing clothes.

Using a community laundry service may challenge these generational norms and create unintended intergenerational social consequences, particularly between younger and older women. These were all critical considerations in the exploration and socialisation of this concept.

Creating economic opportunity

In discussing the idea of a laundry business, consultation with communities was largely positive, with 64% of surveyed households interested in paying for a laundry service. Households in Pango village – a peri-urban area – had a greater interest in paying for a laundry service due their higher disposable income. In testing what would be an accessible cost, those surveyed felt that a service fee between US\$2.50 and US\$4.20 to be achievable. Most believed that using the service every 2 to 3 days would ensure clean diapers would always be available, noting that babies require a greater frequency in



Figure 3: Handwashing in Vanuatu is the most common laundry practice, and considered a feminine duty. © EWB Australia

washing, but that this reduces as the child grows. Essential to implementing a laundry washing service would be its role in motivating continued uptake and use of reusable diapers. Promisingly, 92% of respondents indicated they would continue to use reusable diapers if they could access such a service. In ascertaining if the concept of a community-owned and operated laundry service would be of interest, we explored if community members would attend business plan training to implement the service. All respondents expressed interest, and those that were not interested in starting the business were still open to at least learning more about the idea. To keep the laundry business sustainable in the community, half of the stakeholders identified lack of management skills as a major challenge, and one identified lack of maintenance skills. The service is seen to provide greater equality and inclusion for women to enter the workforce. It also was seen as a meaningful employment opportunity for young men. In peri-urban areas of Vanuatu, there are not many employment opportunities for young men, who often leave the country to seek work in nearby islands. These men were not that interested in talking about the opportunity at first, but later warmed to the concept. Though a laundry service can wash more than cloth diapers, they were seen as a more acceptable item to send to a community laundry service than general clothing. As reusable diapers are relatively new products, focusing on offering a cloth nappy laundering service was seen as an acceptable starting point. If this use gains community acceptance and traction, there may be the possibility to expand the service to general clothing in the future.

Prototyping

EWB Australia consulted with other enterprises developing washing technology options in low income and energy-limited contexts, and tested some of these prototypes. EWB Australia determined that additional prototyping was necessary to ensure that solutions adopted place-based considerations and appropriate technology specific to the Vanuatu context. Some of these are the remoteness of the location, access to water, the limitations to accessing mechanical parts and the cost of shipping parts to the island nation.

Prototype 1

Prototype 1 was developed in partnership with Field Ready, a not-for-profit organisation that works in many regions, including the Pacific, and who specialises in building appropriate technology in the field and with community.

Prototype 1 is a manual washing machine that uses a hand crank mechanism to wash clothes. It was

made locally in Vanuatu using local materials and was developed with household use in mind. Community members who tested Prototype 1 were excited at the prospect of not needing to scrub their clothes. One participant commented that, "It doesn't make your arm sore but can build your muscle, (it's) actually a good exercise." Another noted that using the Tumble Drum prototype involves "less direct contact with the water, especially to avoid catching a cold."

The design required further iteration due to its form (bulky and weighing 80 kilograms) as well as some room for improvement in the quality of the wash.



Figure 4: Community members test existing prototypes. © EWB Australia

Prototype 2

Prototype 2 was developed with pro bono support from Toyota (Australia), with the design evolving alongside a change in its use: from household to community service. It has a stationary outer drum, and an inner drum that spins the water and cleans the clothes. It is operated by pedal power, using the gear mechanisms from a second-hand bicycle that are readily available. In testing, prototype 2 uses a minimal amount of water to effectively remove stains and clean the clothes. The next stage of testing of prototype 2 will monitor a number

of variables to further enhance its design: type of water (saltwater and freshwater), amount of water, spin speed, spin time, type of clothes and amount of detergent. Grey water from the tumble drum would be disposed of via a soakaway, a toilet, or in vegetation away from residential areas.



Figure 5: Prototype 1 under construction. © EWB Australia

Future prototypes

Given the physicality of the Tumble Drum's mechanical operation, the next prototyping phase will explore solar as a power source, addressing issues of inclusion through using a renewable energy source - such as solar, which is readily available in the Vanuatu tropical context - thereby enabling people with disability or physical limitations to operate the unit.

The business model

Prototypes 1 and 2 will shortly be piloted in the community with people interested in operating a laundry service. When the final design is complete, Fiji has been determined as the most feasible location option for parts manufacture. This is due to the availability of skilled technicians, a more advanced production market, availability of parts and cheaper shipping to Vanuatu. The intention would be for parts to be manufactured by Field Ready in Fiji, shipped to Vanuatu and assembled in Vanuatu by community members.

Initial scoping of a business model to support a laundry service would see people interested in a laundry service purchasing a washing machine via a loan arrangement. This would be facilitated through a social enterprise that would order and arrange shipping of the parts, ahead of assembly in Vanuatu. The enterprise will also support training and maintenance. Once the buyer completes their final payment, they would own the washing machine outright.

Conclusion

Whilst the Vanuatu government's proposed disposable diaper ban was the catalyst for ascertaining a supporting environment for reusable diapers, the solution in progress aims to deliver a much broader outcome. Implementation of appropriate technology through provision of the Tumble Drum in community laundry enterprises will provide employment and economic opportunities for both women and young men. It will challenge inter-generational gender norms which burden women with the laundering duties of the household. It encourages product manufacture within Pacific Island nations. And, it is intended to reduce the number of disposable diapers used by creating a more supportive environment for cloth diapers. The findings from this pilot can help inform governments of Pacific Island nations as they continue to grapple with disposable diaper waste.

References

- Dyer, D. (2005). Seven decades of disposable diapers: a record of continuous innovation and expanding benefit. The Winthrop Group, Inc. on behalf of EDANA. <https://www.edana.org/docs/default-source/absorbent-hygiene-products/edana—seven-decades-of-diapers.pdf?sfvrsn=3e24d>.
- EWB Australia. (2022). Tumble Drum Project, Vanuatu - Baseline Report..
- Khoo, S. C., et al. (2019). Recent technologies for treatment and recycling of used disposable baby diapers. *Process Safety and Environmental Protection*, 123, 116–129.
- Miller-Wilson, K. (2021). How many diapers does a baby use in a year? Baby Love to Know. <https://baby.lovetoknow.com/baby-care/how-many-diapers-does-baby-use-year>
- Notten, P., Gower, A., & Lewis, Y. (2021). Single-use nappies and their alternatives: recommendations from Life Cycle Assessments, United Nations Environment Programme (UNEP), Nairobi, Kenya. <https://www.lifecycleinitiative.org/library/single-use-plastic-bottles-and-their-alternatives-recommendations-from-life-cycle-assessments/>
- UNEP. (2018). Single-use plastics: a roadmap for sustainability. <https://www.unep.org/resources/report/single-use-plastics-roadmap-sustainability>
- SPREP. (2022). Research report: assessment of alternatives to single-use disposable diapers. Volume 1: executive summary. <https://library.sprep.org/content/research-report-assessment-alternatives-single-use-disposal-diapers-volume-1-executive>

Writers Profile



Mitch Horrocks

Mitch is the EWB Australia's Technology Development Lead on the Tumble Drum project. He is an Industrial Designer with a strong human-centred design background in developing communities. Mitch studied Industrial Design at the University of Technology Sydney and during his Honours project designed a simple product that enabled rural communities in Uganda to boil water and cook food at the same time, alleviating the stresses related to the lack of access to clean drinking water. He then founded his own charity in Uganda to distribute these products to remote communities. Upon returning to Australia, Mitch joined the EWB team to champion innovation and design as a tool for solving complex problems alongside the communities with which EWB works. Contact: m.horrocks@ewb.org.au.

Stephanie Hamel

Stephanie Hamel is EWB Australia's Country Manager in Vanuatu and is an environmental engineer, Stephanie led the research project commissioned by the Secretariat of the Pacific Regional Environment Programme (SPREP) on the assessment of alternatives to single-use disposable diapers. Since 2006 Stephanie has worked for NGOs in Uganda, Timor-Leste, and the Solomon Islands, as well as consulting with local councils in Australia. Through her studies and experiences, Stephanie has learnt that to work efficiently in the WASH sector, one has to tap into a wide range of skills and behaviours in order to respond to today's wicked problems. She is therefore constantly looking for opportunities to grow her own technical, social and leadership skills, as well as those of colleagues and partners, in order to ultimately create healthier and more resilient living places. Contact: s.hamel@ewb.org.au.



Steve Tarimaemae

As EWB Australia's Technical Program Manager in Vanuatu, Steve drives the scoping and implementation of EWB's Technology Development projects on the island nation. Steve is a Ni-Vanuatu - his family comes from the island of Ambae, north of the country, and he came to Efate (the island of Vanuatu's capital, Port Vila) for his last three years of high school. He then resided in New Zealand for four years to complete his tertiary studies. Steve is a civil and structural engineer, and before joining EWB, worked as a civil engineer on the Vanuatu Infrastructure Reconstruction & Improvement Project in Efate and Tanna Island, Vanuatu. Contact: s.tarimaemae@ewb.org.au.



Cedric Paniel

Cedric is EWB Australia's Technology Development Coordinator based in Vanuatu, working closely with communities on the Tumble Drum project. At EWB, his role is focussed on leading the delivery of the Technology Development program, engaging and building relationships with existing and new partners, and supporting the monitoring and evaluation of EWB Australia's projects in Vanuatu. Cedric was a recipient of the Queen's Commonwealth Trust Award 2019, recognising his activist work in community development, specifically focussed on creating platforms for discussion around youth empowerment, gender equality and climate change. Before joining EWB, Cedric worked in Vanuatu for NGOs, including Oxfam and World Vision. Contact: c.paniel@ewb.org.au.

About Engineers Without Borders

Australia

At Engineers Without Borders Australia, our purpose is to harness and activate the potential of engineering to create an equitable reality for people and the planet. We do this through Education (facilitating real-world workshops with thousands of school students annually; engaging 75% of Australia's engineering tertiary students from 1st-year to PHD in humanitarian engineering learning and research; engaging professionals in participatory learning experiences) and Engineering (through the Asia Pacific with local teams in Cambodia, Timor-Leste and Vanuatu, as well as with First Nations communities in Australia - working alongside communities to achieve their engineering aspirations, so they are not left behind). EWB Australia is part of the EWB International global movement. Visit ewb.org.au



Project Contributors:

Cedric Paniel, Steve Tarimaemae, Prisilla Amkori, Harshana Shrestha, Maria Paula Hernandez Ruiz, Hamish Clark, Hannah Mercader, Mitch Horrocks, Stephanie Hamel, the communities of Pango, Erata and Eton in Vanuatu, Mama's Leaf, Toyota (Australia), Field Ready.

Report writers/editors: Llawela Forrest, Mathi Mithra, Stephanie Preston, Darshanna Umakhanthan.

With thanks to: Department of Foreign Affairs and Trade (Australia), Engineers Australia.