Techathon Report

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SDG3: Clean Water & Sanitation

SDG9: Industry, Innovation & Infrastructure

SDG13: Climate Action

Abstract

This project focuses on improving water transportation in rural areas using a modified design of the Hippo Roller. The existing roller design addresses the challenge of water accessibility but has limitations in ease of use and efficiency and inclusivity. The objective was to develop a more ergonomic and durable solution, Inclusive to all consumers by also utilizing modern manufacturing techniques.
A conceptual model was created using a 3D software and 3D printing to test improvements. Results are anticipated to yield 20% increase in water-carrying capacity and a reduction in user effort. These findings suggest the proposed modifications can significantly enhance the utility of the Roller, contributing to sustainable water access solutions.

The RollerX initiative aligns with and contributes to the United Nations Sustainable Development Goals (SDGs). It directly supports SDG 6 (Clean Water and Sanitation) by improving access to water resources, SDG 9 (Industry, Innovation, and Infrastructure) by leveraging advanced manufacturing methods, and SDG 13 (Climate Action) by promoting sustainable and resource-efficient solutions. These findings emphasize the broader impact of the RollerX design in addressing global challenges while advancing rural community development.

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Introduction

Sufficient clean water access is one of the leading problems African communities are facing at large, mostly rural north African countries like Ethiopia, South Sudan, Somalia and many more. This is mostly because of underdevelopment residents either have fewer working taps per community or they fetch water at rivers this then leads to many people travelling long distances with more trips because of the ineffective way of transporting water.

A solution of the sufficient and efficient water transportation issue was then invented by Grant Gibbs namely The Hippo Water Roller. This is a 90l rollable tank that allows residents to effectively collect water with triple the water capacity compared to the traditional methods of using buckets and reduces the number of trips taken by everyone. This then reduces fatigue and increases the effectiveness of water transportation.

Problem Statement

Despite Hippo Roller's advantages, the current design of the Hippo Water Roller has several downsides. For instance, it does not accommodate every user due to its single-size design, limiting its inclusivity. Additionally, accessing the water inside the barrel can be physically challenging for certain individuals, such as the elderly, people with physical disabilities, or those with limited strength, as they must lift the heavy barrel to retrieve the water.

Aim

To develop an enhanced water transportation device that improves accessibility, usability, and efficiency for diverse communities, addressing the limitations of the existing Hippo Water Roller design.

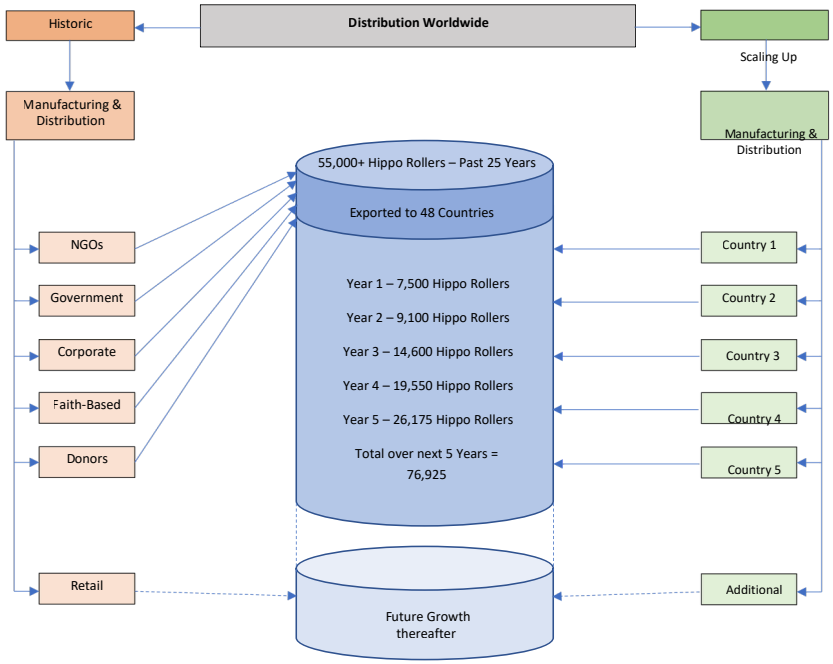
Objective

To address these issues, we introduce RollerX, an enhanced water transportation device designed with inclusivity and alignment with Sustainable Development Goals (SDGs) in mind. RollerX features a more adaptable design that caters to a broader range of users, offering improved usability and accessibility. By tackling the limitations of its predecessor, RollerX aims to provide a more inclusive and effective solution for water transportation across diverse communities.

The Hippo Roller is an innovative social enterprise aimed at addressing the critical global issue of water scarcity. Established in 1991 by South African innovators, it provides a practical solution for transporting water in rural and underserved communities where piped water infrastructure is unavailable.

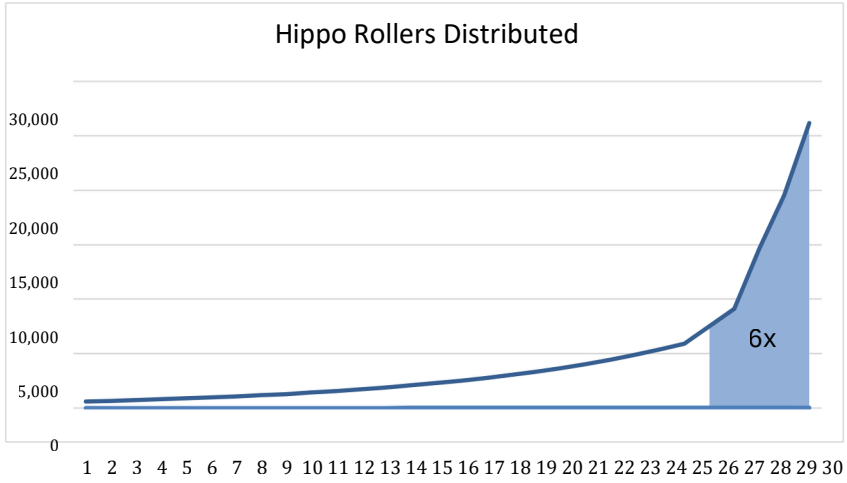
The Hippo Water Rolle served as a Game-Changer in Water Transportation. It is a durable 90-liter barrel designed to ease water collection in rural areas. By rolling instead of carrying, it significantly reduces physical strain while tripling water-carrying capacity compared to traditional methods.

Hippo Roller Structure (Proposed)



With over 55,000 units distributed across 48 countries, the Hippo Roller has significantly improved the lives of millions of people, primarily in Africa, enabling users to carry up to five times more water with minimal effort compared to traditional methods. This product not only saves time and reduces physical strain, but it also unlocks opportunities for education, health, and income generation.

Distribution and Impact



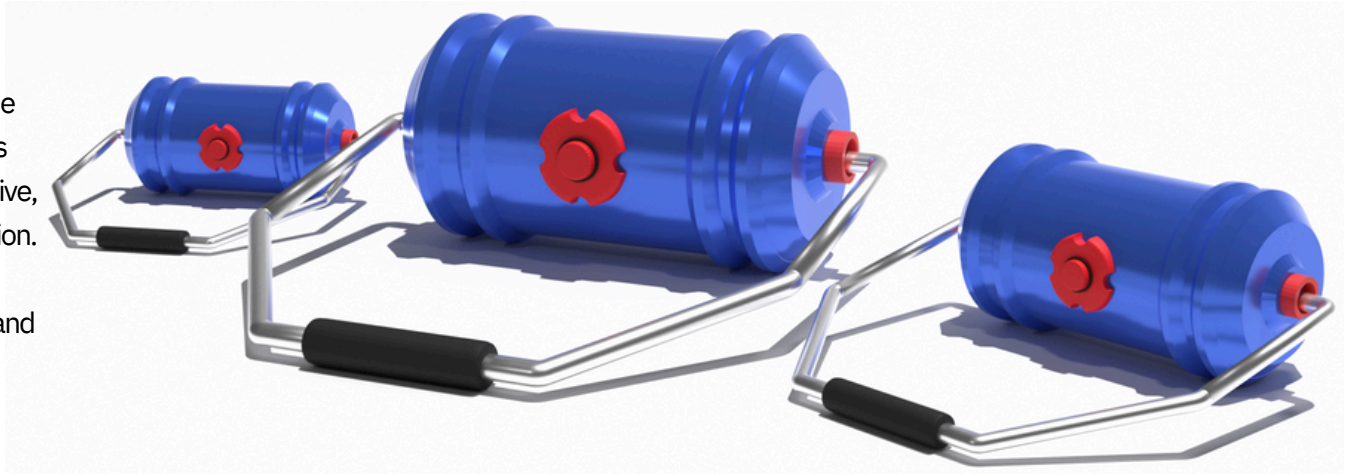
Throughout the years, the Hippo Roller has supplied over 55,000 units in its first 25 years, with a projected distribution of 77,000 additional units over the next five years. This marks a steep rise in its impact, with over 132,000 units expected by its 30th year. The roller has significantly reduced the burden of water collection, saving time and improving opportunities for millions.

Despite its impact, the current design has limitations. Its single-sized structure and awkwardly positioned opening make accessing water physically challenging, particularly for the elderly and disabled.

Its Limitations Include:

Accessibility Issues	Lack of Inclusivity	Environmental Impact
Certain individuals, such as the elderly, physically disabled, or weak, face challenges in lifting the barrel to access the water inside.	The current single sized design does not cater to a wide range of users, limiting its utility for people with varying physical capabilities.	Although durable, the materials used are not always eco-friendly or biodegradable, raising concerns about long-term environmental effects.

RollerX is an advanced and innovative redesign of the traditional Hippo Water Roller, developed to address Hippo Roller's limitations and provide a more inclusive, efficient, and sustainable water transportation solution. By focusing on user-centered design and modern materials, RollerX enhances accessibility, usability, and environmental sustainability.



Improved Accessibility

RollerX features a repositioned opening designed for easier access to water, eliminating the need for lifting the barrel. Combined with a built-in filtration system, it ensures clean, hassle-free water retrieval, making it more convenient for all users, especially those with physical limitations.

Size Ranges

To accommodate people with different physical capabilities, RollerX is available in three distinct size ranges. This adaptability ensures that individuals, regardless of stature or strength, can utilize the roller comfortably, making it a versatile tool for a wide variety of users.

Eco-Friendliness

As part of our commitment to climate action, RollerX is produced using recycled materials, helping to reduce the environmental footprint. This initiative not only supports sustainability but also aligns with global efforts to create a greener and more responsible future.

Enhanced Mobility

The RollerX features specially designed grooves, which enhance mobility by providing better traction and stability. This innovative feature ensures that the roller moves smoothly across surfaces, even in challenging conditions, making transportation more efficient and less strenuous for users.

Filtration system

A built-in filtration system is incorporated into the RollerX, ensuring that the water isclean and free from contaminants. The system uses a multi-layer filter to capture particles and impurities, providing users with access to clean water during transportation. This feature is especially valuable in areas with poor water quality, allowing users to maintain safe, hygienic water without additional external filtration methods.

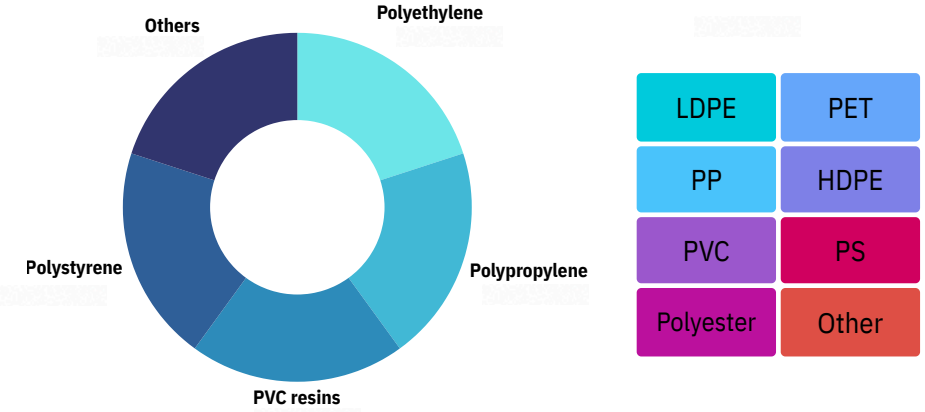
Ergonomic Handle Design

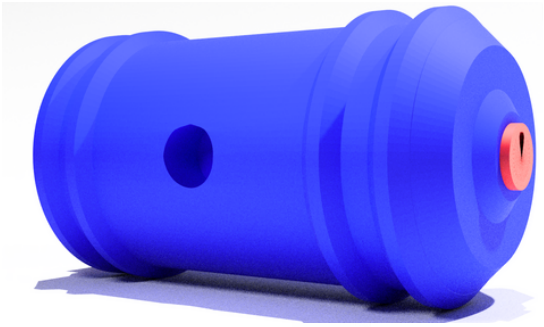
Cleaning and maintaining RollerX is made simple with the convenient opening and detachment mechanism located on the sides. This feature allows users to easily access the interior for cleaning, ensuring hygiene is always a top priority.

Barrell

The barrel of the new roller is constructed with durability and functionality in mind. To ensure longevity and optimal performance, we aim to select materials that meet the following criteria:

- **Durability:** The material must be capable of withstanding wear and tear from prolonged use in rugged environments. (Resistance to Harsh Conditions)
- **Lightweight but Strong:** While ensuring strength and durability, the material should be lightweight to maintain ease of transport and handling.
- **Eco-Friendly Considerations:** Where possible, we strive to use materials that are recyclable or have a minimal environmental footprint.





90litres
45litre
30litre

The barrel is designed to cater to a variety of needs, offering a range of sizes to accommodate different tasks and user preferences.

- **90liters:** The largest capacity, ideal for extensive water transportation
- **45liters**: A medium-sized option that strikes the perfect balance between capacity and portability.
- **30liters:** The smallest option, designed for lighter loads and smaller-scale applications

Repositioned opening: The barrel features a repositioned opening designed for improved accessibility

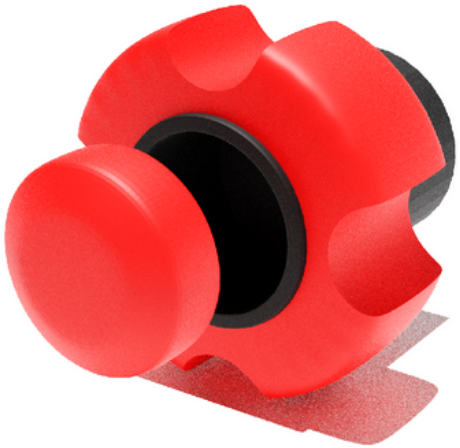
Detachable Sides for Easy Cleaning: The barrel's sides can be detached for quick and thorough cleaning, maintaining hygiene and simplifying maintenance.

Dual Cap

The barrel is equipped with a dual-closure cap system for enhanced convenience and control. This design features:

- **Large Cap**: Provides full access to the barrel's contents, ideal for filling large volumes of water efficiently.
- **Smaller Inner Cap:** Designed for controlled access, allowing users to drain out smaller amounts of water without the risk of water rushing out in large volumes.

This dual-cap system ensures ease of use, minimizes spillage, and accommodates a variety of user needs.



This dual-cap system is designed to provide maximum convenience and functionality for users. The large cap allows for quick and efficient access when filling or emptying the barrel, making it suitable for tasks that require handling larger volumes of water. The smaller inner cap, on the other hand, ensures controlled water flow, allowing users to pour precise amounts without spillage.

Handle

The redesigned handle is engineered to improve both comfort and functionality. Key features include:

Ergonomic Grip:

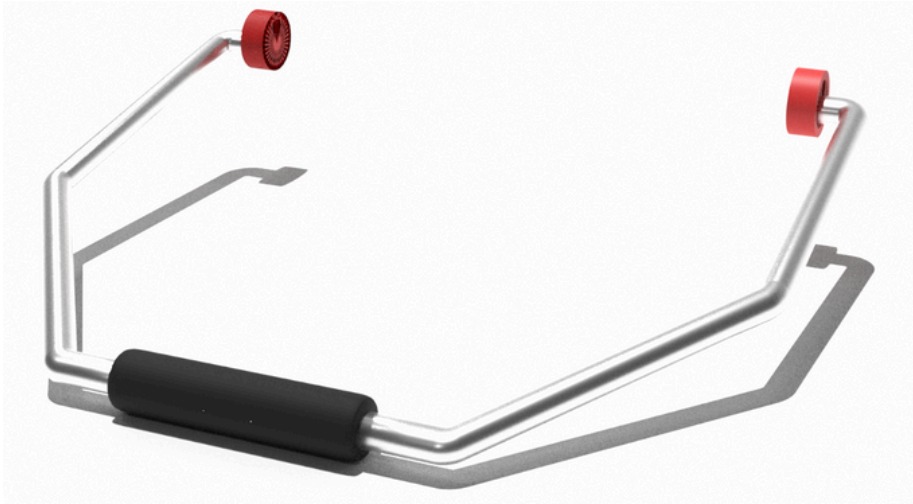
- The handle is designed with a mechanism that allows it to be securely locked in place when needed, providing added stability and balance

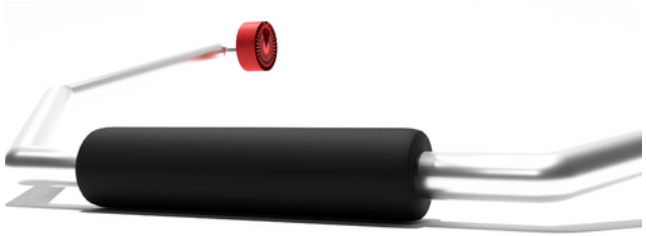
Non-Slip Grip Surface :

- non-slip coating or texture to the handle, ensuring that it remains firmly in the user's hand, even in wet or slippery conditions.

Robust Material:

- Constructed with high-strength materials that resist wear and deformation, the handle is built to withstand frequent use in rugged terrains.





Material:

- **Durable**: All materials are selected for their resistance to wear, abrasion, and harsh environmental conditions.
- **Eco-Friendly:** Manufactured using the use of recycled plastics composites

The combination of materials ensures a lightweight yet strong product, improving user experience and operational efficiency.

Comparative Analysis

Feature	Hippo Water Roller	RollerX
Main Body Material	High-density polyethylene (HDPE)	Recycled plastic or biodegradable composite materials
Handle Material	Steel or basic plastic handle	Lightweight, corrosion-resistant aluminum or reinforced polymer
Dual-Access System	Not included	High-quality grade plastic dual tap system
Environmental Impact	Non-biodegradable, with limited focus on recycling	Designed with a lifecycle approach; recyclable and eco-friendly materials

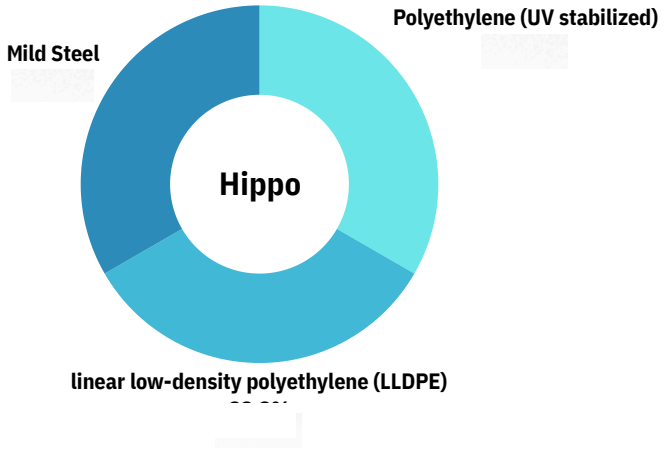
From the materials to the design, RollerX demonstrates significant improvements over the Hippo Water Roller. While the Hippo Water Roller relies on traditional, durable materials like HDPE, RollerX incorporates modern, sustainable, and user-friendly materials that prioritize environmental health and user inclusivity.

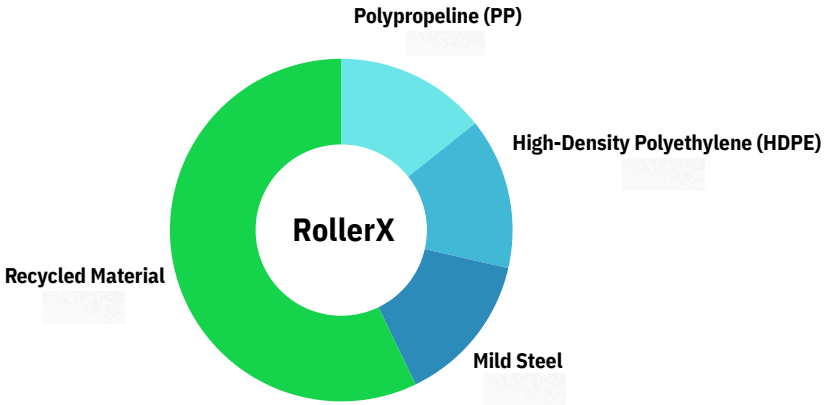
Comparison of Material used

The Traditional **Hippo Roller** consists of three main materials:

- **Polyethylene (UV Stabilized):** Provides durability and resistance to environmental factors such as sunlight and moisture.
- **Linear Low-Density Polyethylene (LLDPE):** Contributes lightweight properties for easier handling and transportation.
- **Mild Steel:** Offers structural support and rigidity, particularly in areas requiring enhanced strength.

While effective for basic usage, this material composition limits opportunities for improved sustainability and weight optimization.





The **RollerX** introduces a refined material composition, emphasizing sustainability and performance. The material distribution is as follows:

- **Recycled Material:** The primary component, reflecting a commitment to eco-friendly practices by reducing reliance on virgin materials and minimizing environmental impact.
- High-Density Polyethylene (HDPE): Adds durability and resistance to impact, making the RollerX suitable for rugged conditions.
- **Polypropylene (PP):** Enhances chemical resistance and structural integrity while maintaining a lightweight profile.
- **Mild Steel :** Retained for its robustness, supporting critical structural components such as the handle.

The RollerX improves upon the Hippo Roller by using recycled materials, enhancing sustainability and aligning with global conservation goals. Its incorporation of HDPE and PP boosts durability and resilience for harsh conditions. These advancements make the RollerX a more sustainable, durable, and user-friendly solution.

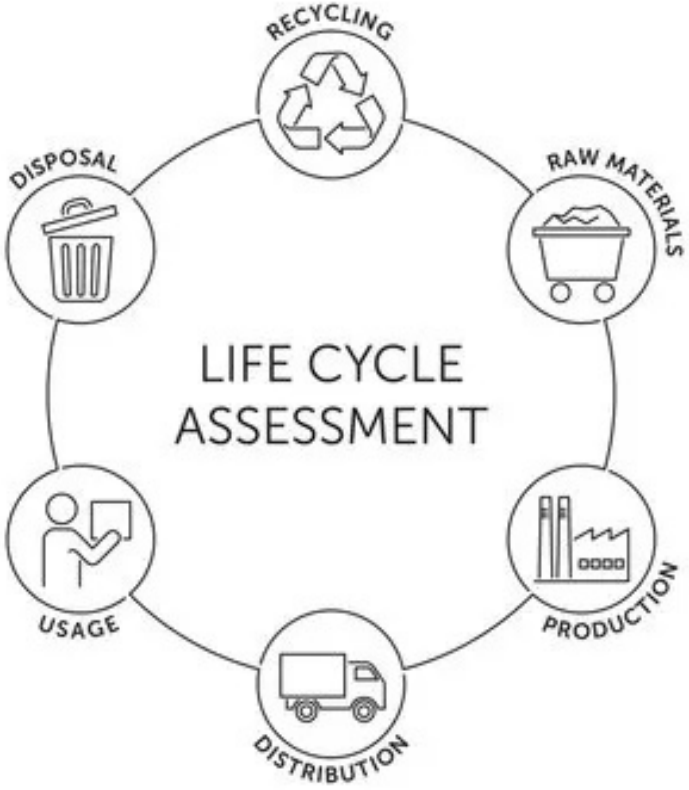
Estimated Costs

The following table outlines the estimated costs associated with the production of 1,000 units of the redesigned Hippo Roller. These costs are based on material procurement, manufacturing, facility and equipment rentals, transportation, marketing, and maintenance considerations:

Manufacturing Component	Cost per Unit	Total (1,000 units)
Material Costs	R440/unit	R440,000
Manufacturing Costs	R390/unit	R390,000
Transportation Costs	R50/unit	R50,000
Marketing and Distribution Costs	R30/unit	R30,000
Maintenance Costs	R240/unit	R240,000
Total Production Cost	**R910/unit**	**R910,000 ($48K)**

Rental:

Automated Molding Machine	R75,000/month	R150,000 (2 months use)
Facility for Manufacturing	R25,000/month	R50,000 (2 months use)
Total Rental Cost		**R200 000 ($10.5k)**



Raw Material Sourcing:

- Recycled HDPE material, reducing dependence on virgin plastic and promoting a circular economy.

Manufacturing:

- Energy-efficient production techniques, including mould injection and material reinforcement for durability.

Distribution:

- The compact and efficient design features foldable handles and stackable barrels, optimizing storage and transportation efficiency. This innovation reduces shipping volumes, leading to lower fuel consumption and greenhouse gas emissions throughout the distribution chain.

Usage:

- Designed for long-term durability, the product reduces the need for frequent replacements, thereby decreasing waste generation over time.

End-of-Life (EOL) :

- At the end of its life cycle, the product is designed for easy disassembly, enabling the recycling of components effectively.
- Customers are encouraged to return used products for either recycling or refurbishment, allowing materials to be reused in the creation of new units. This process marks the beginning of a new product cycle, further promoting a circular economy and reducing overall waste.

ARBURG ALLROUNDER 720 | *Automated Molding Machine*

Setup Time: 30 minutes to 2 hours
Injection Phase: 30–50 seconds.
Cooling and Ejection: 60–90 seconds.
Estimated Cycle Time: 1.5–2.5 minutes per part (average: 2 minutes).

Traditional Molding Machine

Setup Time: 1 - 2hours.
Injection Phase: 2–5minutes.
Cooling and Ejection: 3 -5minutes.
Estimated Cycle Time: 5–10 minutes per part

RollerX is expected to be manufactured through modern manufacturing processes to ensure high production rates, and a quick market adoption as an initiative to a community out reach.

An Automated high-performance injection molding machine is proposed to be utilized to ensure all expectations are met.

These are expected production rates expected in the manufacturing of a 90l barrel for RollerX.

Production Output:

- Least Setup Time = 382 units/hour
- Highest Setup Time = 356 units/hour

Production Rate:

- Least Setup Time = 16 units/hour
- Highest Setup Time = 15 units/hour

see index fig

Downtime Assumed to account for 5% of the total shift time, equivalent to 72 minutes.

The ARBURG ALLROUNDER 720 outperforms traditional molding machines in productivity and 24-hour operational capability. Its advanced features, including automated processes and optimized resource usage, enable high-volume production with significantly reduced material and energy consumption. This efficiency not only lowers production costs but also makes RollerX more affordable, supporting its mission to improve water accessibility for underserved communities.

Sustainable Development Goals

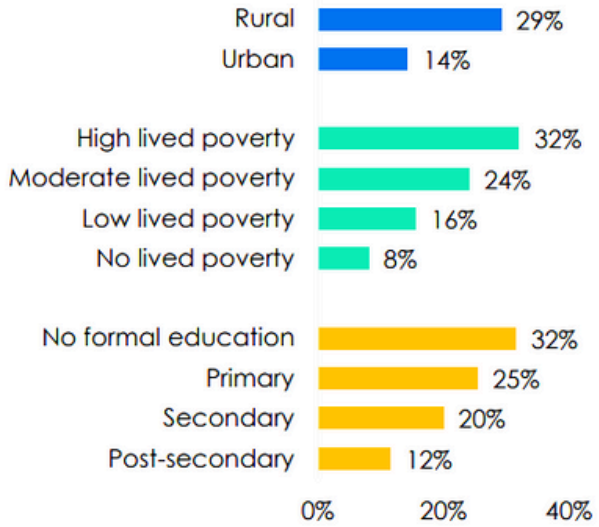
The RollerX project aligns with the United Nations Sustainable Development Goals (SDGs) by addressing key challenges faced by rural and water-scarce communities. The following SDGs are directly supported by this project:

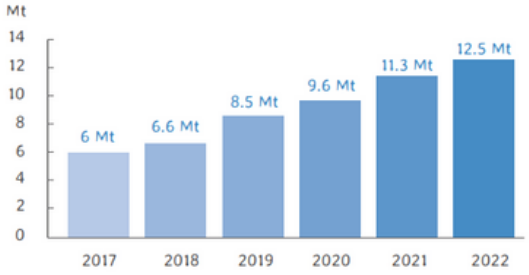
SDG 6: Clean Water and Sanitation

The RollerX project aligns closely with the principles of SDG 6, which emphasizes ensuring access to clean water and sanitation through sustainable and equitable management. By improving water transportation efficiency and reducing physical burdens, the project fosters inclusive solutions that empower communities, particularly vulnerable groups, to access clean water more effectively.

- **Goal:** To Ensure availability and sustainable Transportation of water and sanitation for all.

Figure 3: Water supply as a top priority





- **Project Impact:**
  - By enhancing the Hippo Roller's design, the project aims to improve water transportation efficiency, making it easier for rural households to access clean water.
  - Reducing the physical burden and time spent on water collection ensures a more sustainable and equitable distribution of clean water resources in underserved areas.

SDG 9: Industry, Innovation, and Infrastructure

The water roller project aligns closely with the principles of SDG 9, emphasizing innovation and sustainable industrialization. The project prioritizes modern industrial manufacturing processes, such as 3D printing and automated injection molding, to produce RollerX efficiently and sustainably. By leveraging these advanced methods, the project reduces material waste, enhances production scalability, and ensures high-quality, durable solutions, contributing to the development of resilient infrastructure and inclusive economic growth.

sustainable industrialization:

- The project fosters sustainable industrialization by prioritizing modern industrial manufacturing processes, such as 3D printing and automated injection molding, to produce RollerX efficiently and sustainably. By leveraging these advanced methods, the project reduces material waste, enhances production scalability, and ensures high-quality, durable solutions, contributing to the development of resilient infrastructure and inclusive economic growth

fig2 : **Arburg Allrounder 720** *automated injection molding machine*

Sustainable Infrastructure:

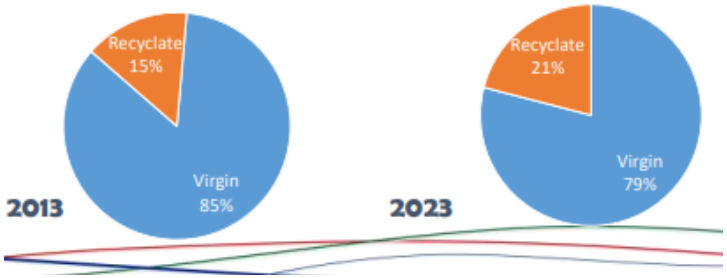
- the project incorporates eco-friendly materials and user-centric features, addressing water access challenges while contributing to the development of resilient infrastructure. By offering a durable and scalable solution, RollerX empowers underserved communities, ensuring long-term social and economic benefits.

SDG 13: Climate Action

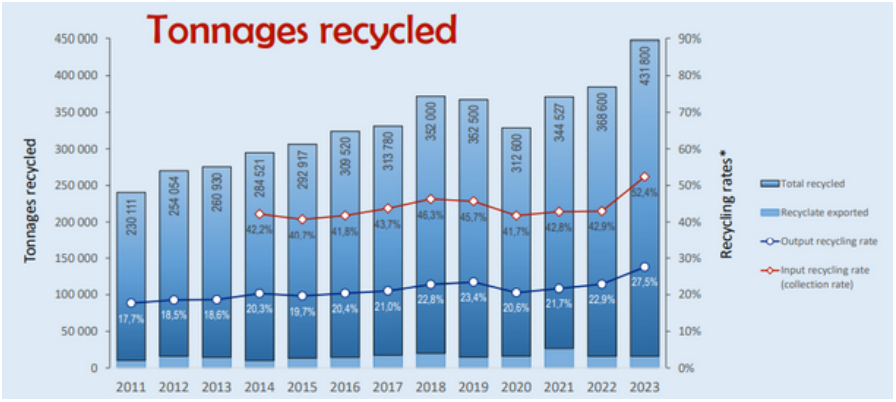
The redesigned Hippo Roller incorporates sustainable materials and energy-efficient production processes, demonstrating a commitment to reducing environmental impact and contributing to global climate action initiatives.

The Hippo Roller project aligns with SDG 13, Climate Action by promoting the use of recycled plastic in its production. By utilizing recycled materials, the project helps reduce the demand for virgin plastics, lowering CO2 emissions and decreasing plastic waste. This contributes to climate action by supporting sustainable practices and reducing the environmental impact of plastic products.

According to statistics released by Plastic SA, South Africa has made notable progress in plastic recycling, with the percentage of recycled plastics increasing from 15% in 2013 to 21% in 2023. The RollerX aims to be a contributor in eliminating plastic waste that still piles up on landfills



Source: *Plastics| SA - 2023 summary - Plastics Recycling*



Source: *Plastics| SA - 2023 summary*

The increasing tonnage of recycled plastics in South Africa reflects a positive trend in reducing plastic waste and promoting sustainable practices. As shown in the graph, both the total amount of recycled plastics and the output recycling rate have steadily increased, demonstrating a growing commitment to sustainability.

The RollerX project aligns directly with this growth by utilizing recycled plastic in its production. Its execution will support this initiative and potentially scale up the total output units over the year

Key Stakeholders

The stakeholders involved in the project include:

End-Users:

- Rural families, particularly women and children, who will use the Hippo Roller for water collection.
- Farmers and small-scale agricultural workers who require efficient water transport solutions.

Community Leaders and Local Organizations:

- Local chiefs, community representatives, and NGOs who advocate for water accessibility solutions.
- Organizations focusing on rural development, water access, and sustainability initiatives.

Manufacturers and Suppliers:

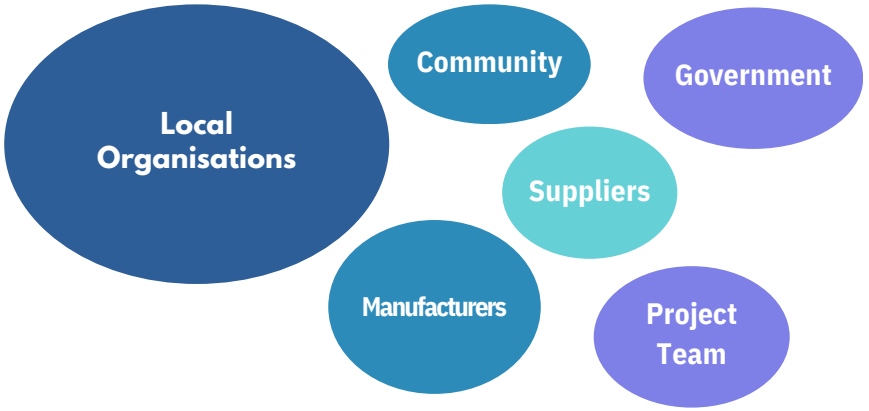
- Companies or individuals responsible for producing and supplying the RollerX.
- Material suppliers who provide components for the product's design improvements.

Government and Policy Makers:

- Local government departments focused on water and sanitation infrastructure.
- Policy makers working to meet **Sustainable Development Goals** (SDGs)

Project Team:

- The project group members, technical experts, and academic supervisors contributing to the design and development process.



Community Focus:

The primary focus of this project is rural and water-scarce communities where access to clean and safe water is limited. These communities often rely on traditional methods, such as carrying water in buckets or containers over long distances, which is physically demanding and time-consuming. Women and children are disproportionately affected as they are primarily responsible for water collection, which impacts their health, education, and economic productivity.

Improving the Hippo Roller design will directly benefit these communities by:

- Reducing physical strain during water collection.
- Enhancing water accessibility, especially in areas with poor infrastructure

CONCLUSION:

In conclusion, the RollerX project offers a transformative solution to address the pressing issue of water access in underserved communities. By incorporating eco-friendly materials and user-centric features, the project not only addresses immediate water transportation needs but also contributes to the development of resilient, sustainable infrastructure. Its durability and scalability ensure that it can have a long-term positive impact, supporting communities' social and economic development.

The integration of sustainable materials and design reflects the project's commitment to minimizing environmental impact, while the focus on empowering underserved populations ensures equitable access to essential resources. This solution has the potential to be expanded and adapted to other regions, providing a model for future infrastructure projects that prioritize both environmental responsibility and community empowerment.

While the project has shown significant promise in its current phase, lessons learned throughout its implementation process offer valuable insights for continuous improvement. Going forward, further exploration into enhancing efficiency, increasing scalability, and integrating new technologies will strengthen its impact and reach.

Ultimately, RollerX exemplifies the essence of resilient infrastructure—one that not only meets immediate needs but also fosters long-term social, economic, and environmental benefits. As such, it aligns with the broader goals of sustainable development and serves as a testament to the power of innovative, community-focused solutions.

https://www.plasticsinfo.co.za/wp-content/uploads/2024/10/Executive-Summary-Plastics-2023.pdf

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Hippo Roller USA, n.d. Hippo roller. [online] Available at: https://www.hipporollerusa.org/ [Accessed 11 January 2025].

$T_{effective} = T_{cycle} + T_{offload}$

$T_{effective} = 2+1,5 = 3,5$

Min Setup

$OT_{min} = 1440 - 30 - 72$

$OT_{min} = 1338\ min$

$\text{Total Output}_1 = \frac{OT_{min}}{T_{effective}}$

$\text{Total Output}_2 = \frac{1338}{3,5}$

$\text{Total Output}_1 \approx 382\ units$

$\text{Total Output}_1 \approx 382\ units$

MAX Setup

$OT_{MAX} = 1440 - 120 - 72$

$OT_{MAX} = 1248\ min$

$\text{Total Output}_2 = \frac{OT_{MAX}}{T_{effective}}$

$\text{Total Output}_2 = \frac{1248}{3,5}$

$\text{Total Output}_2 \approx 356\ units$

$\text{Total Output}_2 \approx 356\ units$

Productivity

$\text{Productivity}_1 = \frac{\text{Total Output}_1}{\text{Hours Operated}}$

$\text{Productivity}_1 = \frac{382}{24} \approx 16$

$\therefore P_1 \approx 16\ units/Hour$

$\text{Productivity}_2 = \frac{\text{Total Output}_2}{\text{Hours Operated}}$

$\text{Productivity}_2 = \frac{356}{24} \approx 15$

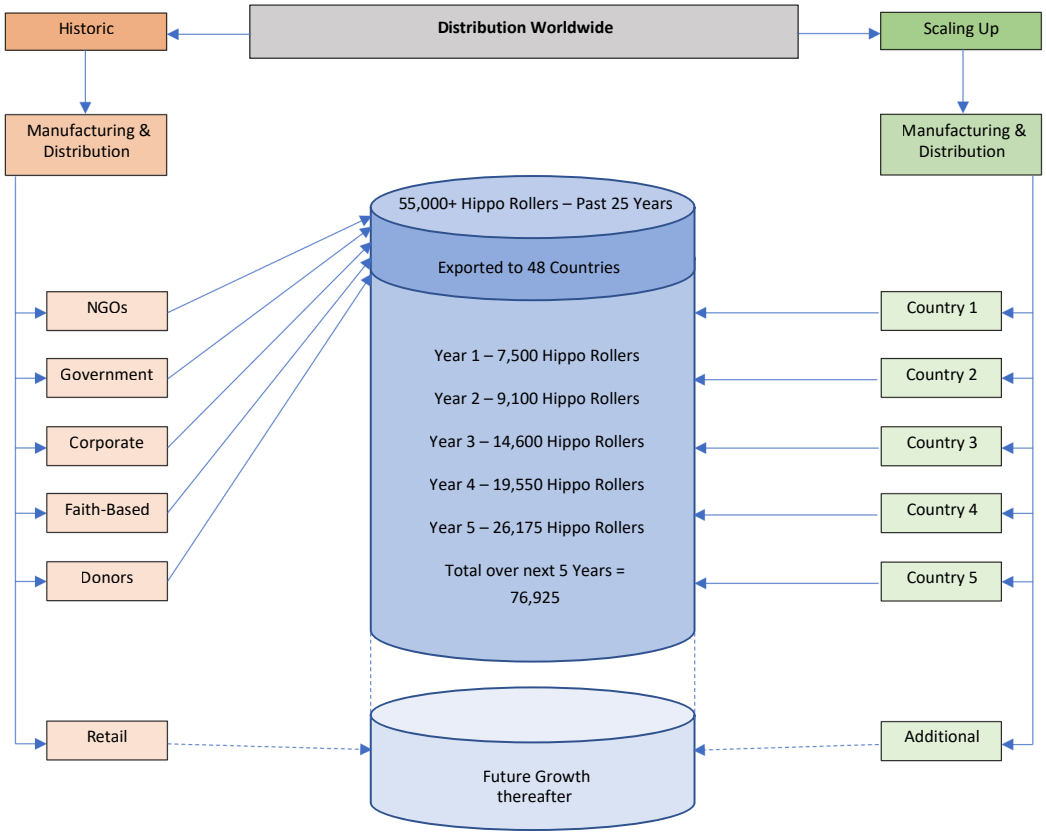
$P_2 \approx 15\ units/Hour$

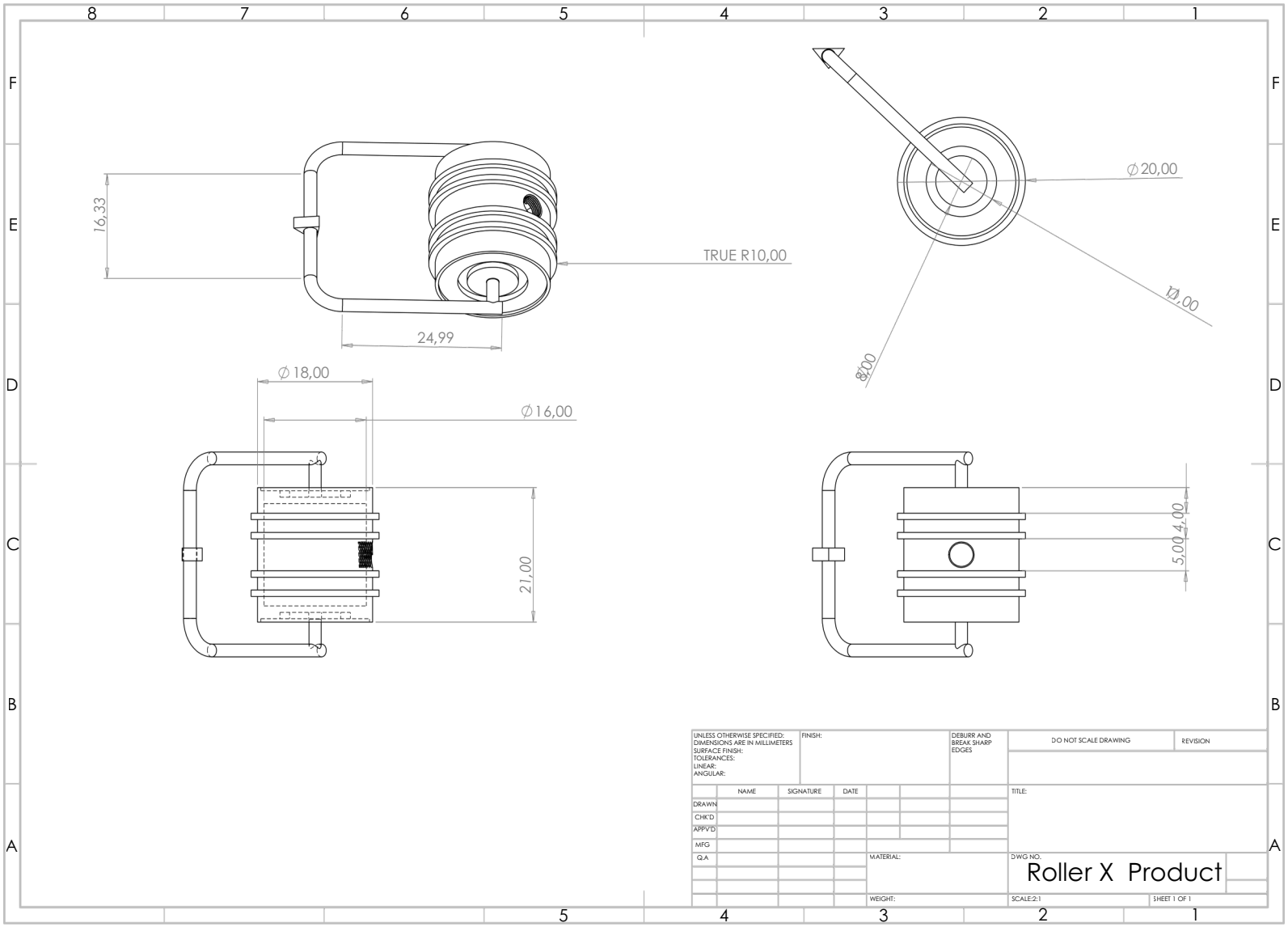
The expected production output rates are expected to be 382units/per hour for the least setup time and 356units/hour for the the higest one

The expected productivity rates are expected to be 16units per hour for the least setup time and 15units per hour for the maximum.

Therefore

Hippo Roller Structure (Proposed)

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∅20,00
∅18,00
∅16,00
21,00
4,00
5,00
Roller X Product

SOLIDWORKS