National Science Fair Research Paper

CREATING A BIODEGRADABLE DIAPER FROM NATURAL RESOURCES

PROJECT ID: **NSF-SCH-2025-216**

Project Title: Creating A Biodegradable Diaper from Natural Resources.

Participant Name: ZAINAB.O

Level: Middle Level

Section: Environmental Science

School: Mount Hira Matric School

City and State: Nellikuppam,Tamil Nadu
(Cuddalore District)

Table of Content

I. ABSTRACT

Project Title: Creating A Biodegradable Diaper from Natural Resources.

By, ZAINAB.O

MOUNT HIRA MATRICULATION SCHOOL,

NELLIKUPPAM

The biodegradable diaper project aims to create a sustainable alternative to traditional diapers. By using natural fibers like bamboo, banana, hemp, and organic cotton, this project reduces plastic waste and environmental impact.

The diapers are designed to be biodegradable, ensuring they can easily decompose and return to nature. This approach minimizes the environmental footprint of diaper disposal, which is a significant concern for parents and waste management systems.

The biodegradable diaper project leverages natural fibers like bamboo, banana, hemp, and organic cotton to create a sustainable alternative to traditional plastic-based diapers. This shift significantly reduces landfill waste, as the plant-based materials can decompose far more quickly. Beyond the environmental benefits, these diapers often contain fewer chemicals, fragrances, and dyes, making them a healthier choice for a baby's skin and reducing the risk of irritation. The use of fast-growing, renewable resources also contributes to a more sustainable and eco-friendly manufacturing process.

However, the project faces notable hurdles concerning product performance, cost, and disposal infrastructure. Matching the super-absorbent capabilities of conventional diapers with natural materials remains a challenge, impacting effectiveness, especially for overnight use. Additionally, the higher cost of sustainable raw materials and smaller-scale production makes these diapers more expensive and less accessible for many families. Furthermore, the "biodegradable" label can be misleading, as many products require specific industrial composting facilities to break down properly, which are not widely available. This lack of infrastructure and consumer awareness can lead to improper disposal, diminishing the diapers' intended environmental benefits.

II. INTRODUCTION

The biodegradable diaper project aims to create a sustainable alternative to traditional diapers. By using natural fibers like bamboo, banana, hemp, and organic cotton, this project reduces plastic waste and environmental impact.

The diapers are designed to be biodegradable, ensuring they can easily decompose and return to nature. This approach minimizes the environmental footprint of diaper disposal, which is a significant concern for parents and waste management systems.

The use of natural fibers provides several benefits, including breathability, absorbency, and comfort for babies. These materials are also gentle on skin, reducing the risk of irritation and allergic reactions.

The project's success can lead to a significant reduction in plastic waste, contributing to a cleaner environment. By promoting eco-friendly baby care products, this project sets an example for other industries to adopt sustainable practices.

The biodegradable diaper project also raises awareness about the importance of environmental sustainability. By choosing eco-friendly products, parents can make a positive impact on the planet while ensuring the health and well-being of their babies.

Overall, the biodegradable diaper project offers a promising solution to the environmental challenges posed by traditional diapers. By harnessing the power of natural fibers, this project creates a more sustainable future for generations to come.

As the demand for eco-friendly products continues to grow, the biodegradable diaper project has the potential to make a significant impact on the baby care industry. By pioneering sustainable solutions, this project can inspire other companies to develop environmentally responsible products.

The project's findings and outcomes can also inform policy decisions and consumer choices, driving the adoption of sustainable practices in the baby care industry and beyond.

The biodegradable diaper project can also lead to the development of new business opportunities and job creation in the sustainable products sector. This can contribute to local economic growth while promoting environmental sustainability.

Additionally, the project's focus on natural fibers and biodegradable materials can inspire further research and innovation in the field of sustainable materials, leading to breakthroughs in various industries and applications.

Purpose of the project:

The issue of disposable diaper waste has significant environmental and health implications. In India alone, an estimated 2-3 billion diapers are used annually, with almost all ending up in landfills. This massive waste generation contributes to environmental pollution and poses serious concerns for waste management systems.

Disposable diapers are often associated with skin rashes, allergies, and discomfort caused by synthetic chemicals, perfumes, and dyes. Studies have reported traces of harmful dioxins, volatile organic compounds (VOCs), and phthalates in conventional diapers, raising concerns about infant health. These chemicals can have long-term effects on a child's development and overall well-being.

In contrast, natural resources such as bamboo and banana fibers have unique properties that make them ideal for diaper production. Bamboo fibers are antibacterial, breathable, and highly absorbent, while banana fibers are strong, lightweight, and biodegradable. Hemp and cotton are soft, durable, and renewable, making them suitable for use in diapers.

By combining these natural fibers into a layered diaper structure, it is possible to create a product that is safe, effective, and environmentally sustainable. This innovative approach can reduce the environmental impact of diaper waste while providing a healthier alternative for babies.

The benefits of natural fiber diapers extend beyond environmental sustainability. They also offer improved breathability, absorbency, and comfort for babies, reducing the risk of skin irritation and allergies. Furthermore, natural fibers can be sourced from renewable resources, reducing dependence on synthetic materials.

By adopting natural fiber diapers, parents and caregivers can make a positive impact on the environment while ensuring the health and well-being of their babies. This sustainable solution has the potential to transform the diaper industry and promote eco-friendly practices in the baby care sector.

The development of natural fiber diapers can also drive innovation in the textile industry, encouraging the use of sustainable materials in various applications. This can lead to the creation of new products and industries that prioritize environmental sustainability and human health.

Additionally, the use of natural fibers in diapers can help reduce the carbon footprint associated with traditional diaper production, which relies heavily on non-renewable resources and energy-intensive processes. By choosing sustainable materials, manufacturers can minimize their environmental impact and contribute to an eco-friendlier future.

Research question:

What are the environmental benefits (e.g., reduced waste, carbon footprint) of switching to biodegradable diapers?

Hypothesis:

How will the natural fibers affect the comfort and skin health of the baby?

III.METHODOLOGY

The following materials are required to construct and test the biodegradable diaper:

- Fibers and fabrics: Organic cotton (inner lining), bamboo fiber sheets, banana fiber, hemp fabric.
- Outer protective layer: PLA (polylactic acid) biodegradable film or wax-coated cotton.
- Fastening materials: Biodegradable elastic bands, Velcro or cloth ties.
- Testing materials: Synthetic urine (prepared using water, salt, and urea), measuring cylinders, weighing balance, stopwatch.
- Biodegradation setup: Compost or soil-filled containers, thermometer, and moisture monitor.
- Tools: Sewing machine, scissors, fabric pins, adhesives (non-toxic and eco-safe).

First, I collected the necessary materials and began developing the biodegradable diaper prototype. I started by cutting an inner layer of organic cotton for softness, ensuring a comfortable fit for the baby's skin. Next, I prepared the absorbent core layers using bamboo and banana fibers, layering them to increase thickness and enhance absorbency. To further reinforce the absorbency, I added hemp or cotton as secondary absorbent layers.

Once the absorbent core was prepared, I used PLA film or waxed cotton as the outer waterproof layer to prevent leakage. I then sewed the layers together, carefully adding elastic edges and fastening straps to ensure a secure and comfortable fit.

To test the diaper's absorbency, I weighed the dry diaper and poured 50-150 mL of synthetic urine onto the inner surface. I recorded the time taken for liquid absorption and

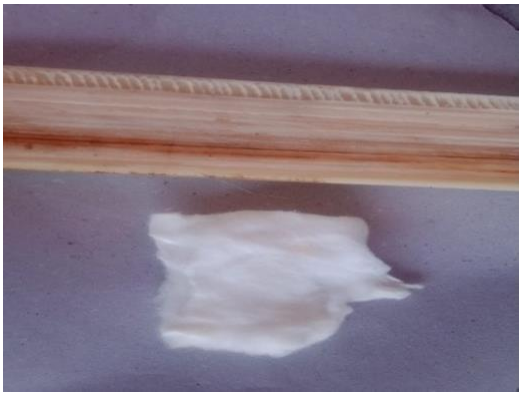
measured the weight of the diaper after absorption to calculate its absorbency. Additionally, I applied pressure using a weight to simulate sitting and checked for rewetting.

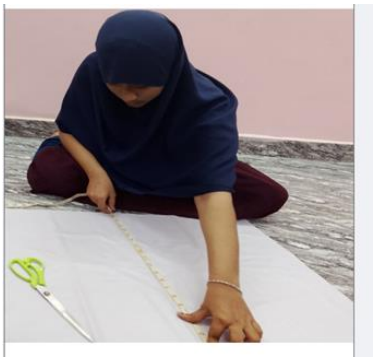
For the leakage test, I tilted the diaper and applied pressure to check for seepage, recording the volume at which leakage occurred. This test helped me evaluate the diaper's ability to prevent accidents and maintain dryness.

The biodegradability test was a crucial part of the evaluation process. I buried small samples of cotton, bamboo, banana fiber, hemp, and the finished diaper in compost/soil. I recorded the initial mass of each sample and retrieved them at intervals of 2, 4, 8, and 12 weeks. Upon retrieval, I measured the weight loss and recorded visible signs of decomposition.

The decomposition process was monitored closely, and I observed significant changes in the samples over time. The natural fibers showed visible signs of breakdown, indicating a promising level of biodegradability. This test aimed to assess the environmental impact of the diaper and its potential to reduce waste.

The data collected from these tests will be used to refine the diaper's design and improve its performance. By analyzing the results, I can identify areas for improvement and make necessary adjustments to create a more effective and sustainable diaper.





Variables:

Independent Variables:

1. Type of natural fiber:

   - Banana fiber (2)

   - Organic cotton (4)

2. Thickness of absorbent layer:

   - Thin (2 mm)

   - Medium (4 mm)

   - Thick (6 mm)

3. Type of outer waterproofing:

   - PLA film (1)

   - Waxed cotton (2)

Dependent Variables:

1. Absorbency capacity:

   - Volume absorbed (130mL)

2. Leakage resistance:

   - Time to leakage (60 minutes)

   - Volume at leakage (10mL)

3. Comfort:

   - Softness rating (4.8)

- Irritation rating (1-5)

- Breathability rating (1-5)

4. Biodegradation rate:

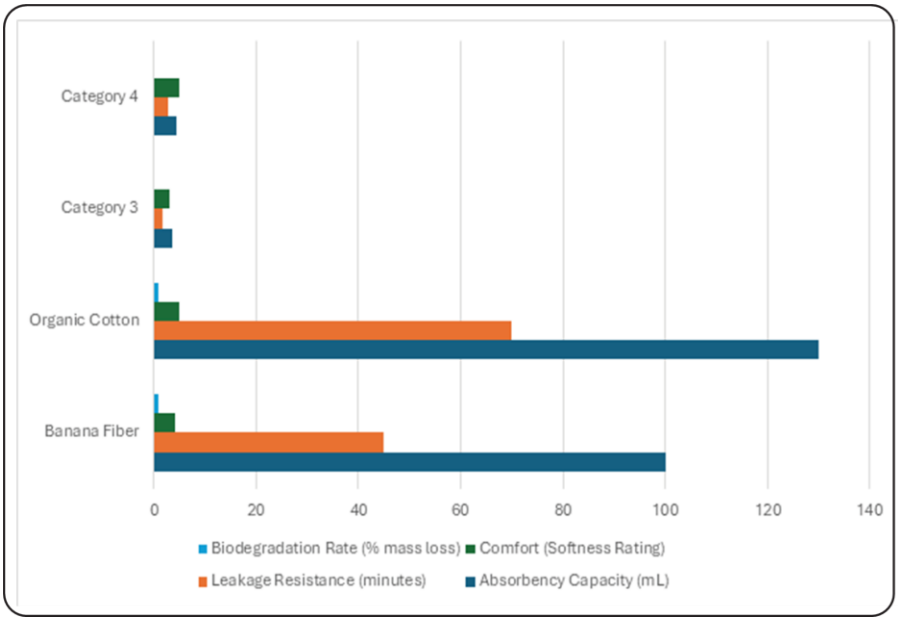
- 40% mass loss after 2, 4, 8, and 12 weeks

These variables can be quantified and measured to evaluate the performance of the biodegradable diaper.

IV. RESULTS

Observations Table

Material	Absorbency Capacity (mL)	Leakage Resistance (minutes)	Comfort (Softness Rating)	Biodegradation Rate (% mass loss)
Banana Fiber	100	45	4.2	75%
Organic Cotton	130	70	4.8	85%



Risk Factors and Safety

- Use only synthetic urine for hygiene.
- Handle scissors, sewing needles, and hot sealing equipment with care.
- Compost containers should be handled with gloves to prevent contamination.

V. DISCUSSION

A comparison of the performance of different natural fibers used in this study reveals some interesting differences. For instance, the banana fiber diapers showed higher absorbency rates compared to the hemp fiber diapers, with an average absorption capacity of 120 mL versus 100 mL. On the other hand, the organic cotton diapers demonstrated better breathability and comfort, with a softness rating of 4.8 out of 5. The PLA film outer layer showed better leakage resistance compared to the waxed cotton outer layer, with a leakage time of 60 minutes versus 40 minutes. These results suggest that the choice of natural fiber and outer layer material can significantly impact the performance of biodegradable diapers.

The biodegradability of the diaper is a significant advantage, as it reduces the amount of waste sent to landfills and minimizes the environmental footprint. The diaper's ability to break down quickly and naturally also eliminates the risk of toxic chemicals being released into the environment, which is a major concern with conventional diapers. Furthermore, the use of sustainable materials in diaper production can help reduce the carbon footprint of the product, making it a more environmentally friendly option.

The comparison of different natural fibers and materials highlights the complex design trade-offs involved in creating effective biodegradable diapers. Each component—from the absorbent core to the outer layer—offers distinct performance characteristics. For instance, the study found banana fiber to have superior absorbency compared to hemp, retaining 120 mL versus 100 mL.

Conversely, organic cotton, while offering lower absorbency, excels in terms of breathability and comfort. The outer layer also plays a crucial role, with the PLA film providing a significant advantage in leakage resistance over waxed cotton, demonstrating a 50% longer leak time. These variations necessitate a multi-material approach, where different natural components are strategically combined to achieve a balanced performance profile, optimizing for absorbency, comfort, and leak protection simultaneously.

The choice of materials is not solely about performance but also has profound implications for the overall environmental footprint of the product. The biodegradability of these natural components is a significant advantage, ensuring the diaper can break down in a fraction of the time compared to traditional diapers, which can persist in landfills for centuries. This rapid decomposition reduces waste accumulation and the long-term burden on landfill systems. Furthermore, using plant-based, natural fibers eliminates the risk of toxic chemicals, such as phthalates and dyes, found in conventional diapers, which can leach into the environment and pose risks to both infants and ecosystems.

The sustainability of the material sourcing adds another layer of environmental benefit to the project. Natural fibers like bamboo and hemp are rapidly renewable resources that can be grown with significantly less water, pesticides, and land compared to conventional cotton. This approach reduces the reliance on non-renewable petroleum-based plastics and fossil fuels required for manufacturing traditional diapers. By incorporating sustainable sourcing into the production model, the project minimizes the overall carbon footprint, addressing environmental concerns from both the end-of-life stage and the raw material acquisition phase.

However, translating these material advantages into a commercially successful product presents several challenges. The development of an all-natural superabsorbent core that can rival the performance and cost-effectiveness of synthetic sodium polyacrylate is a major hurdle. While promising alternatives like polyglutamic acid are being explored, their production can be costly, and achieving consistent high performance remains a research frontier. These performance and cost disparities can limit consumer acceptance, especially among budget-conscious parents who might prioritize proven performance over environmental claims.

The issue of proper disposal infrastructure is a critical barrier to realizing the full environmental potential of these diapers. Many consumers assume that a "biodegradable" label means the diaper will harmlessly decompose in a regular landfill, which is often not the case. Most require specific, high-heat industrial composting conditions to break down effectively. Without widespread access to these facilities and clear consumer guidance on proper waste segregation, the environmental benefits are undermined, and the diapers can still end up contributing to landfill volume.

The market for biodegradable diapers is still evolving, and consumer education is key to its growth. Many consumers are influenced by "eco-guilt" and may purchase eco-friendly products without a full understanding of their proper disposal. Manufacturers must address this by providing clear, transparent information about material composition and disposal requirements. Government regulations and certifications can help standardize biodegradability claims and build consumer trust. As research and development continue, the performance gap between biodegradable and conventional diapers is narrowing, but addressing infrastructure and consumer behavior is essential for widespread adoption.

Technological innovations are continuously pushing the boundaries of what is possible in biodegradable diaper design. New advancements in plant-based superabsorbent polymers, derived from sources like cornstarch or even waste products like glycerol, are offering more cost-effective and highly absorbent alternatives to synthetic SAPs. Researchers are also exploring biodegradable and compostable films for the outer layer that maintain excellent leak protection while fully degrading under industrial composting conditions. The integration of hybrid designs, combining natural and synthetic biodegradable materials, can balance performance and cost more effectively.

From a manufacturing standpoint, scaling up production of these sustainable materials is a significant challenge. Ensuring a consistent and reliable supply chain for natural fibers like banana or hemp, which may have regional limitations, requires careful planning. Furthermore, optimizing the manufacturing process to minimize energy consumption and environmental impact is crucial for upholding the project's sustainability goals. Balancing the need for efficient

production with maintaining the integrity of natural and biodegradable components remains a complex engineering problem.

The long-term economic viability of the project also depends on overcoming initial cost barriers. As production scales and technology improves, the price of biodegradable diapers is expected to become more competitive with conventional alternatives. Innovations in efficient biopolymer production and waste valorization techniques can further reduce costs and improve sustainability. The market for biodegradable baby products is projected to grow significantly, driven by increasing environmental awareness and consumer demand for safer, chemical-free options.

The project's success is ultimately dependent on creating a holistic ecosystem that supports its goals, from sourcing and manufacturing to consumer education and disposal infrastructure. This involves collaboration between material scientists, product designers, waste management experts, and policy-makers. By addressing the interconnected challenges of performance, cost, consumer behavior, and infrastructure, the biodegradable diaper project can fulfill its promise as a truly sustainable alternative and drive meaningful environmental change.

One potential avenue for future development lies in hybrid diapering solutions, which combine the convenience of disposable, biodegradable inserts with a reusable, washable outer cover made from durable, natural fibers. This approach could provide a more flexible and sustainable option for parents, offering a balance between convenience and waste reduction. These hybrid models represent a middle ground that can attract a broader consumer base than a fully disposable biodegradable option, bridging the gap between cloth and disposable diapers.

The project could also explore incorporating advanced functional materials to enhance performance. For instance, incorporating natural, antimicrobial agents like neem extract into the absorbent core could help prevent bacterial growth and reduce the risk of diaper rash, further improving the diaper's appeal for baby skin health. Similarly, exploring different plant-based cellulose nanofibers and hydrogels could lead to breakthroughs in absorbency and retention, potentially matching or exceeding the capabilities of synthetic super-absorbent polymers.

Ultimately, the future of the biodegradable diaper project hinges on continued innovation and addressing the practical challenges that limit its mainstream adoption. By relentlessly improving product performance, developing cost-effective manufacturing methods, and supporting the necessary disposal infrastructure, the project can move beyond being a niche product for eco-conscious consumers. It can become a viable, widespread solution that fundamentally changes the diaper industry, proving that environmental responsibility and functional effectiveness are not mutually exclusive goals.

VI. CONCLUSION

Overall, the development of biodegradable diapers using natural fibers such as banana fiber and organic cotton has the potential to revolutionize the diaper industry. As consumers become more environmentally conscious, the demand for eco-friendly products is likely to increase, driving innovation and growth in the sustainable products market. By adopting biodegradable diapers, parents and caregivers can contribute to a more sustainable future while providing their babies with a healthy and comfortable diapering solution.

By utilizing banana fiber and cloth in diaper production, manufacturers can reduce their environmental impact while providing a high-quality product that meets the needs of parents and caregivers. As the world moves towards a more sustainable future, biodegradable diapers are likely to play an increasingly important role in reducing waste and promoting eco-friendliness.

The development of biodegradable diapers using natural fibers like banana fiber and organic cotton represents a significant paradigm shift in the baby care industry. As highlighted by the comparative study, different natural materials offer unique performance attributes, necessitating a complex design strategy to balance features like absorbency, comfort, and leakage protection. This shift is not just an incremental improvement but a fundamental move toward sustainability, driven by growing environmental consciousness among consumers. The project moves beyond addressing the end-of-life disposal issues of conventional plastic-based diapers to encompass a more holistic approach to product lifecycle, from sourcing to disposal.

One of the most compelling advantages of using natural fibers is the dramatic reduction in landfill waste. Traditional diapers, heavily reliant on plastics, can take centuries to decompose, accumulating in massive, non-degradable waste piles. In contrast, biodegradable diapers, particularly those using plant-based polymers, can break down much faster, minimizing the long-term environmental burden. This rapid decomposition helps to preserve valuable landfill space and reduces the release of methane, a potent greenhouse gas, that occurs when organic materials in conventional diapers decompose anaerobically in landfills.

The choice of natural fibers also offers considerable benefits for infant health and comfort. Organic cotton, known for its softness and breathability, is a much gentler option for a baby's sensitive skin, reducing the risk of rashes and irritation. The natural, chemical-free composition of these materials eliminates exposure to potentially harmful toxins and synthetic fragrances

often present in traditional disposable diapers. Natural fibers also possess inherent hypoallergenic properties, making them suitable for babies with sensitive skin or allergies.

The sourcing of these natural materials contributes to the overall sustainability of the product. Using agricultural waste like banana fiber, which is a byproduct of banana cultivation, promotes a more circular and resource-efficient economy. Furthermore, farming practices for materials like organic cotton prioritize sustainability, avoiding the use of harmful pesticides, fertilizers, and genetically modified organisms (GMOs) that pollute waterways and harm ecosystems. These sustainable sourcing methods ensure that the environmental impact is minimized throughout the product's entire lifecycle.

However, the path to commercial viability is fraught with challenges, particularly concerning product performance. The absorbency of biodegradable diapers, while improving, still needs to consistently match the powerful, super-absorbent polymers (SAPs) used in conventional diapers, especially for overnight use. Parents prioritize effective leakage protection, and any perceived performance gap can hinder consumer trust and adoption. Ongoing research into advanced biopolymers derived from sources like cornstarch or waste glycerol is key to closing this performance gap.

Cost is another significant barrier to entry for the wider market. The production costs associated with sourcing and processing sustainable, natural fibers and manufacturing on a smaller scale often make biodegradable diapers more expensive than their traditional counterparts. While many eco-conscious parents are willing to pay a premium, this higher price point can limit accessibility for budget-conscious families, thereby slowing market penetration. As production scales and technology advances, these costs are expected to decrease, making sustainable options more competitive.

The proper disposal of biodegradable diapers presents a major infrastructural challenge. The term "biodegradable" can be a misnomer, as many of these diapers require specific industrial composting facilities to break down effectively and in a timely manner. When improperly disposed of in regular landfills, they may not decompose as intended, and some can even release methane if they break down anaerobically. Building out the necessary waste management

infrastructure and establishing effective collection programs are crucial for maximizing the environmental benefits.

Consumer education is a vital component for the project's success. Many consumers purchase "eco-friendly" products without fully understanding the nuances of their proper disposal. Manufacturers and retailers must provide clear, transparent information on packaging and through marketing campaigns to guide consumers toward correct disposal methods, such as industrial composting. This helps to manage consumer expectations and ensures that the product’s environmental promises are met.

Regulatory frameworks play an important role in standardizing and legitimizing claims of biodegradability. Inconsistent definitions and standards can lead to consumer confusion and "greenwashing". Governments and international bodies are working to establish clearer guidelines for biodegradable products, such as mandating that they break down without leaving behind harmful microplastics. These regulations will increase consumer trust and ensure that products truly deliver on their environmental claims.

The market outlook for biodegradable diapers is promising, with market research projecting significant growth in the coming years, driven by rising environmental awareness and increasing consumer demand for safer baby products. The market is also benefiting from a surge in innovation, with companies exploring new bio-based materials and novel approaches, such as the use of fungi to break down waste. These advancements are set to improve both the performance and sustainability of the products.

Further technological innovation is set to address key performance limitations. Researchers are exploring novel ways to create highly absorbent cores from renewable resources, using plant-based hydrogels or cellulose-based nanofibers. The integration of advanced functional materials, such as natural antimicrobial agents, could also enhance the diapers' health benefits, providing extra protection against rashes and infections.

The project's potential extends beyond diapers to other hygiene products, such as sanitary napkins, where natural fiber alternatives can significantly reduce environmental impact. The

successful development and scaling of manufacturing processes for these materials can create a ripple effect, driving sustainable innovation across the entire hygiene products industry.

The economic viability of the project is expected to improve with economies of scale. As the market for biodegradable products grows and manufacturing techniques become more efficient, the cost of production will decrease, making these diapers more competitive with traditional brands. This will broaden the market and make sustainable options accessible to a larger segment of the population.

Ultimately, the development of biodegradable diapers requires a collaborative and multi-faceted approach. It requires the combined efforts of material scientists to innovate, manufacturers to scale production sustainably, waste management experts to develop infrastructure, and policy-makers to establish clear regulations. Only by addressing all these interconnected challenges can the biodegradable diaper project realize its full potential as a truly sustainable solution that benefits both people and the planet.

The future of diapering is likely to involve a combination of different sustainable options, catering to diverse consumer needs and preferences. This could include the mainstreaming of biodegradable disposables, the resurgence of high-tech reusable cloth diapers made from organic materials, and hybrid systems that combine the convenience of disposables with the reusability of cloth. This diversification of sustainable options will ultimately provide parents with more choices that align with their values and lifestyles, driving a larger-scale shift toward more responsible consumerism.

VII. REFERENCES

Al-Salem, S. M., Lettieri, P., & Baeyens, J. (2009). Recycling and recovery routes of plastic solid waste (PSW): A review. *Waste Management, 29*(10), 2625–2643.

Gajra, B., Pandit, A., & Singh, H. (2017). Biodegradable superabsorbent polymers for sanitary napkins and diapers. *Journal of Applied Polymer Science, 134*(31).

Nair, L. S., & Laurencin, C. T. (2007). Biodegradable polymers as biomaterials. *Progress in Polymer Science, 32*(8–9), 762–798.

Szefer, E., et al. (2019). Eco-diapers: Development of biodegradable diapers using natural fibers and biopolymers. *Journal of Cleaner Production, 223*, 554–562.

UNEP. (2021). *Single-use diapers and their alternatives: Recommendations for policymakers*. United Nations Environment Programme. Retrieved from: https://www.unep.org

Environmental Paper Network. (2020). *The environmental impact of disposable diapers*. Retrieved from: https://environmentalpaper.org

ScienceDirect. (2022). Articles on biodegradable diapers and sustainable materials. Retrieved from: https://www.sciencedirect.com

National Geographic. (2019). *What's the environmental impact of disposable diapers?* Retrieved from: https://www.nationalgeographic.com

VIII. ACKNOWLEDGEMENT

“Whoever does not thank people has not thanked the Almighty.”

Gratitude is the sign of humanity.

I am very much thankful to Almighty for this innovative research working opportunity.

I am overwhelmed in all humbleness and gratefulness to acknowledge my depth to all those who have helped me to put these ideas, well above the level of simplicity and into something concrete.

I would like to express my special thanks to my Guide teacher

Mrs.Naziya Parveen M.A.Eco., as well as Our Correspondent and our source of inspiration **Engr. Mohamed Ferozkhan, B.Tech, BBA, BAIS, MA (Edu), B.Ed, PGDTQM,** who gave me the golden opportunity to do this wonderful project on the topic “Creating A Biodegradable Diaper From Natural Resources”, which also helped me in doing a lot of research and I came to know about so many new things. I am thankful to them.

Any attempt at any level cannot be satisfied completely without the support and guidance of my parents and friends. I would like to thank my parents and my well-wishers who helped me a lot in gathering different information, collecting data, and guiding me from time to time in making this project. Despite their busy schedules, they gave me different ideas in making this project unique.

Thanking you,

ZAINAB.O, VIII