



ADDRESSING ENVIRONMENTAL IMPACT FROM SANITARY PRODUCTS THROUGH TECHNOLOGY

A Focus on Women's Health and Hygiene



DST-AMRITA
TECHNOLOGY
ENABLING
CENTRE

INTRODUCTION

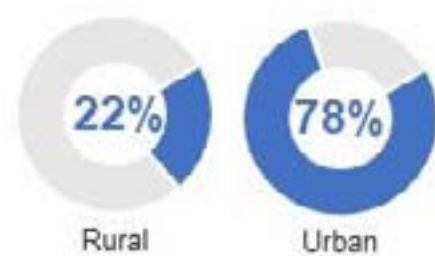
A multipronged effort to use technology to boost women's MHM can be seen all over India. Having private toilets and sanitation facilities and especially access to clean water is a critical part of MHM. However, many rural women in India do not have access to such infrastructure. Millions still defecate in the open or into open bodies of water and dump menstrual waste in such places too.

In our qualitative and quantitative studies (Achuthan et al., 2021) on women's menstrual hygiene management in rural India, we provided early evidence on how women as small business owners, homemakers, wives, students and rural dwellers were affected by COVID-19 in terms of physiological, economic, financial, domestic and WASH related needs.

Particularly, our study identified intrinsic factors such as cultural stereotypes and other deep-rooted socio-psychological norms and extrinsic factors such as the global pandemic that impact women's habits and circumstances, making menstrual hygiene management a massive public health issue. A key concern of our study was the environmental impact of women's choices of menstrual management material.

336 Million

Women of Reproductive age in india



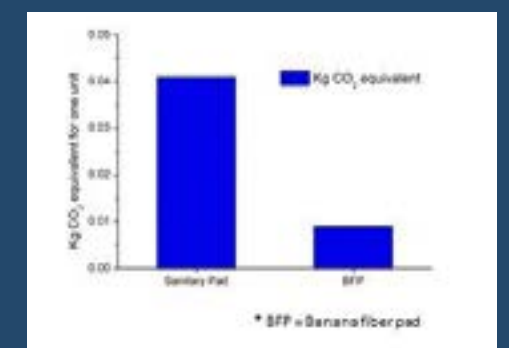
113,000 Tonnes
Menstrual Waste Per Year
in India

ADVENT OF THE DISPOSABLE SANITARY NAPKIN

Every year tonnes of non-biodegradable menstrual waste clog and pollute water bodies and sewage systems. However, these same pads are distributed at low cost (Mahajan, 2019) and are widely available in remote parts of India too. A plethora of MHM interventions revolve around increasing access to plastic-based sanitary pads. In a country as populous as India, which lacks robust waste management systems, the increasing adoption of disposable pads is a double-edged sword. Part of the problem in India's waste management system is that sanitary waste is often hand-picked by waste pickers, leading to spread of diseases too.

The below table provides detailed description of the various layers within the non-biodegradable sanitary pad such as:

- Raw Materials
- Their Function
- Biodegradability
- Raw Material Source
- Environmental Impact
- Health Impact



Layers	Raw Material		Function	Biodegradability	Raw material source	Environment impact	Health Impact	Reference
Fluid Acquisition Layer(FAL) & Fluid Distribution Layer(FDL)	Cross linked cellulose fibers(primary) and any of the secondary fibers or its combination.	1. Cellulose 2. Non-woven Polyester 3. Polypropylene 4. Polyethylene 5. Lycocel	Interim acquisition of large amount of fluid. And often supports the function of a fluid distribution layer.	Not readily	1. Wood pulp 2. Petroleum	1. Deforestation on producing wood pulp 2. polluted soil and marine life 3. Cotton production requires high amount of chemical pesticide polluting the soil 4. 10000 litres of water to produce 1 kg of cotton 5. Clinging of water bodies due to the plastic layers	1. Cellulose dust in production cause major lung disorders. 2. orthoester as plasticizers is a potential endocrine disrupter 3. Chlorine presence as result of bleaching of wood pulp 4. Contact dermatitis due to acrylate presence 5. Byproduct of bleaching process dioxins, potential carcinogen	(Sustainability-10-04146-v2.pdf), [encyclopedia.com], [US927341992] (hal-m2011respiratory/le-spiratory health effects and exposure to superabsorbent polymer and paper dust-an epidemiological study)
Fluid Distribution Layer(FDL)	Thermoplastic (80-80% by weight) Hydrophilic absorbent material(20%)	1. Polypropylene 2. Polyethylene	Thermoplastic prevents capillary collapse and hydrophilic absorbent material draw fluid towards absorbent core keeping the surface layer dry.	Not readily	1. Petroleum			[Jascen1987sanitary], [Sanitary napkin with fluid transfer layer].
Fluid Absorbent Structure(FAS)	Multiple layers of absorbent material with undetectable thin layer of impervious material separating the layers.	1. Rayon 2. cotton 3. Sodium Poly acrylate (SAP) air laid with pulp 4. Cellulose hydrate 5. cellophane layer 6. glass microfibers	Absorbent core absorbs the fluid for long time and is capable of retaining the fluid by preventing the back flow under pressure. Compressed absorbent mass can improve the retentive properties	Biodegradable	1. Wood pulp 2. Petroleum 3. Acrylic acid and NaOH(SAP) 4. Silica based fibers 5. Glass fibers			[vita1960sanitary, Sanitary napkin], [U.S. Pat. No. 3,525,338], [Shourie n2008superabsorbent], [US3771525A], [US4713953A]
Fluid Impervious Membrane (FIM)	Thin layer of impermeable membrane	1. Low density Polyethylene	Fluid impermeable sheet prevents leakage.	Not readily	1. Petroleum			[mahonja2018biodegradability, Biodegradability of polyethylene by bacteria and fungi from Dandora dumpsite Nairobi Kenya]
Adhesion Layer	Adhesive present in between the different layers and below the FIM	1. Polyacrometic / Polyolefinic block copolymer 2. Hydrocarbon resins 3. mineral oil	Keeps the multiple layers of the pads together and also helps to fix the pad on the undergarments.	Poorly biodegradable	1. Petroleum			[Whittington1981dermatitis], [Dermatitis from UV acrylate is adhesive]

ALTERNATIVE REUSABLE & BIODEGRADABLE MATERIALS

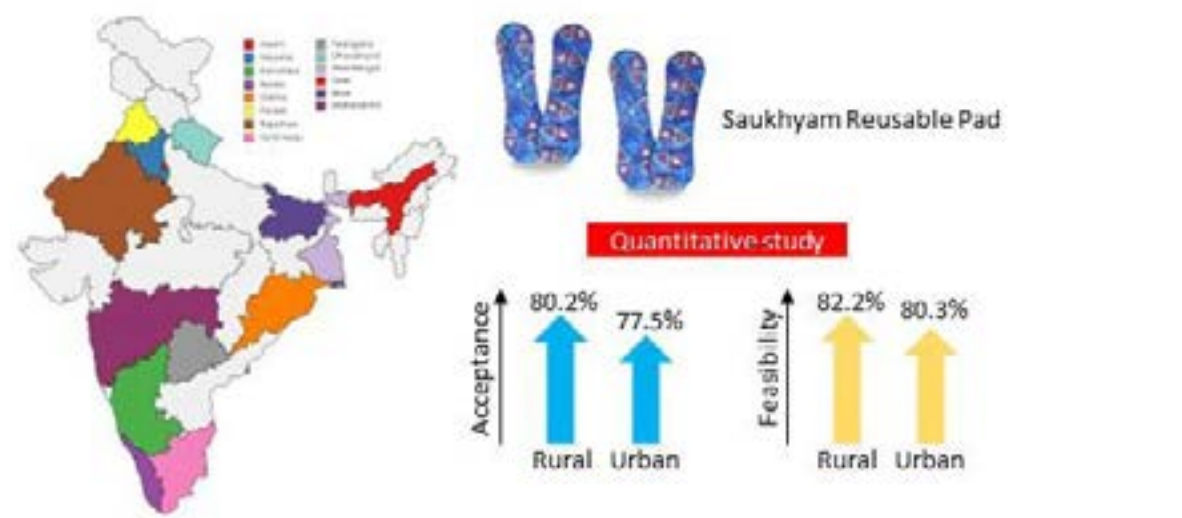
An urgent need to increase awareness and find alternatives to disposable pads was identified by our study. An interesting finding in our study was that rural women are comfortable with traditional methods of managing menstruation, using cloth and cloth-based pads etc. as previous generations of women in their households had done. They also have no resistance to washing and re-using soiled cloths. A microbial study conducted within our study confirmed that the best disinfectants for women to prevent infections are washing reusable cloth pads with soap and drying them in the sun. Another of our key findings in both these studies was that women are interested in the product being feasible in terms of comfort, convenience and cost while still environmentally friendly. There was a definite interest to adopt environmentally friendly MHM materials. However, barriers to commercialisation of such eco-friendly pads in India are very strong and difficult to take down and will be elaborated upon in later sections. In India, competitive products are still disposable pads that are aggressively marketed by multinationals (e.g. Procter & Gamble (P&G)).

Further, in urban areas especially, there is rising disposable incomes while in rural areas, disposable pads are nearly free or free of cost. These factors have contributed to the gradual replacement of traditional methods to manage menstruation (Lopez, 2020).

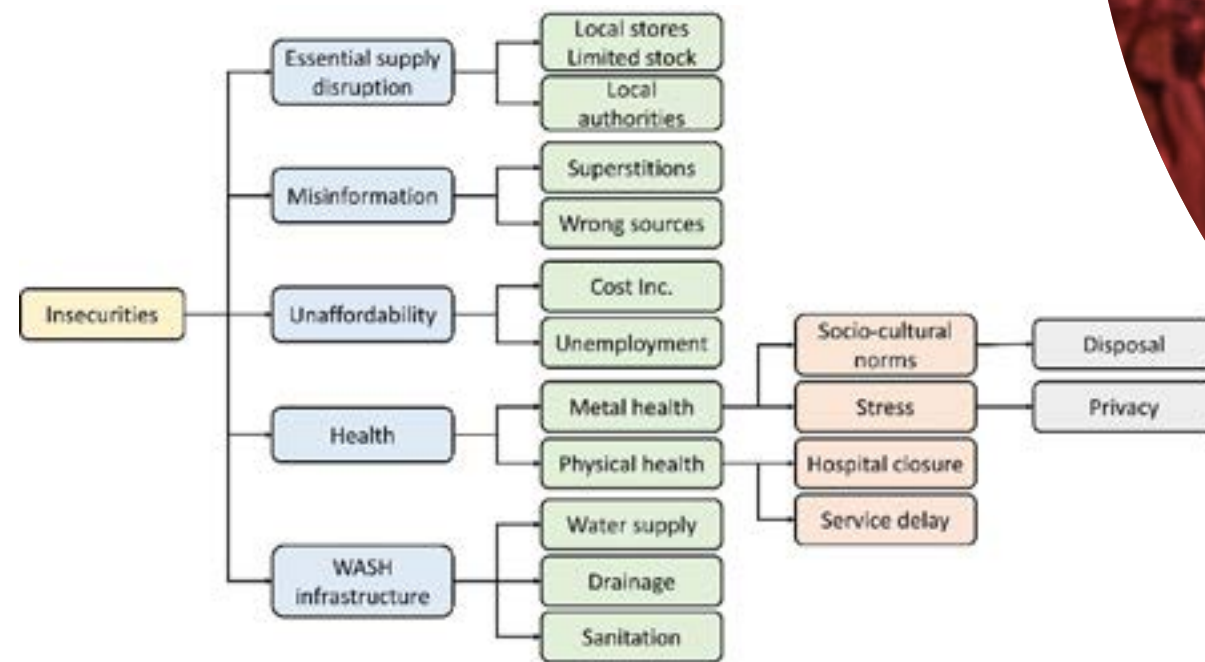
The below table provides detailed description of the various layers within the biodegradable sanitary pad such as:

Layers	Raw Material		Function	Biodegradability	Raw material source	Environment impact	Health Impact	Reference
Fluid Acquisition Layer(FAL) & Fluid Distribution Layer(FDL)	Thin layers wool fiber needled punched into 100% cotton non-woven fabric	1. Wool fiber 2. Non-woven cotton fabric 3. Water Hyacinth paper 4. Banana fiber	Interim acquisition of large amount of fluid. And often supports the function of a fluid distribution layer.	Biodegradable	1. Animal hair 2. Cotton 3. Jute fiber	1. Cotton production requires high amount of chemical pesticide polluting the soil 2. 10000 litres of water to produce 1 kg of cotton. 3. LD-Polyethylene used for back sheet is not readily biodegradable	1. Allergic responses towards wool and other fibers. 2. Contact dermatitis due to bee wax	[Barman2017development,], [pitakoka2013water], [Shendosa2017contact]
Fluid Absorbent Structure(FAS)	Sandwiched SAP between Natural fibers. Blend of different fibers also is used.	1. SAP 2. Organic and inorganic Cotton 3. Bamboo Fiber 4. Water Hyacinth 5. Banana Fiber	Absorbent core absorbs the fluid for long time and is capable of retaining the fluid by preventing the back flow under pressure. Compressed absorbent mass can improve the retentive properties	Biodegradable	1. Cotton 2. Bamboo 3. Jute 4. Acrylic acid and NaOH(SAP) 5. Wood pulp			[Barman2017development,], [pitakoka2013water]
Fluid Impervious Membrane (FIM)	Thin layer of low density polyethylene	1. LD-Polyethylene 2. Corn starch layer 3. Bee wax	Fluid impermeable sheet prevents leakage.	Biodegradable	1. Petroleum 2. Corn 3. Natural Bee wax			[Barman2017development,], [Bunney1968contact,], [pitakoka2013water]
Adhesive Layer	Adhesive present in between the different layers and below the FIM	1. resins 2. Bee wax 3. Polyacrometic / Polyolefinic block copolymer 4. hydrocarbon resins 5. mineral oil	helps to fix the pad on the undergarments.	Biodegradable / Non Biodegradable	1. Plant resins 2. Natural Bee wax 3. Petroleum			[Bunney1968contact,], [Whittington1981dermatitis], [pitakoka2013water]

The Saukhyam Reusable Sanitary Napkin, an eco-friendly cloth-based pad using banana fiber as the absorbent material, was piloted in our first study amongst women from 5 south Indian villages. The product rated very highly in terms of the above-mentioned determinants of acceptability to the women especially because of their ability to prevent leakage similar to disposable pads, reusability and slow degradation. During COVID-19, we submitted a deeper qualitative study building on this, in two south Indian villages in districts with high COVID-19 rates.



In our study, we found that rural women, especially, need wider community (NGOs, volunteers etc) and technological support to increase access to such pads, obtain WASH infrastructure as well as report issues close to their hearts with regard to size, leakage, design, wear and tear etc. and obtain help without delay. Other issues such as sensitivity around visible pad disposal and drying and finding private spaces to change pads were also identified. In the qualitative study, deeper and more insidious troubles



that affect the quality of women's MHM during COVID-19 emerged. During lockdown, the way women chose menstrual products, managed menstrual cramps, managed workloads with more people in the house, managed domestic violence exacerbated by alcohol, managed obtaining water, went to agricultural or manual labour jobs, managed stress and mental health issues from loss of livelihood and fines imposed etc. changed drastically and affected MHM or their menstrual cycles and flows. For schoolgirls who relied on schools as a primary source of pad supply, school closures for 2 years cut off the supply totally forced them to resort to using rags. Our qualitative study shed light on the results on each of these areas in depth. The reusability of alternative menstrual materials was discovered to be most useful to combat some COVID-19 related barriers to MHM such as having to wait for government issued pad supply or fear over not finding enough pads at local shops. However, not enough research and data exists on the need for reusable and biodegradable products in India and on the need for inclusivity of such products in the mainstream market. Other reasons, in addition to the environmental crisis, are now cropping up to further this agenda.

A 2022 study proposes policy changes after it confirmed the lack of pad supply in areas with strict lockdowns during the early days of the pandemic. It found clear evidence of the impact of lockdown intensity on the provision of sanitary pads, with districts with the strictest lockdown restrictions suffering the most as sanitary pads distribution was overlooked during the pandemic, leaving girls and women vulnerable to managing their menstrual needs (Babbar et al., 2022)

Our data supports these findings as our study participants from such areas reported facing harsh punishment from law enforcement officers and heavy fines beyond their earning scope that increased their stress levels too. In our qualitative study, we also discovered that misinformation is always rampant in communities with low literacy and exposure. People make poor choices due to wrong information, ignorance or lack of choices. At that time, obtaining quantitative data on any of the problems identified above was extremely difficult.

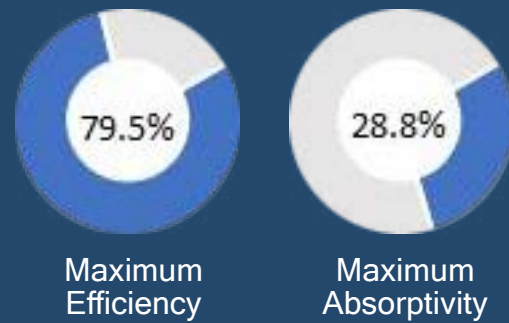
Although the qualitative paper utilised data from two south Indian states, data was actually collected by our team amongst women in more states in India for a more representative picture of new challenges Indian women faced with regard to obtaining menstrual management material and other experiences that obstructed their MHM. During the lockdown, face-to-face meetings were not allowed. As MHM is still taboo in many parts of India, in depth discussions were not possible with participants. Further, male data collectors faced reluctance from the women and difficulty to capture their experiences. In view of that, phone calls were made and communities were mobilised to speak to neighbours. The data was collected from the following states and translated.

Technology innovations on MHM @Amrita



Pulverising Unit

Banana Fiber



A team lead by Professors from mechanical engineering department, Amrita School of Engineering designed a pulverizing unit to convert raw banana fiber in the form of strands to strands of smaller lengths in the length of 8-15 mm. design is obtained.

They were conducted various experiments to obtain the optimum number of blades for the maximum absorptivity of the banana fiber specimen. Based on the experiments comparisons were made on the various parameters like number of blades, grain size and absorptivity and an optimum

“BFP is a promising consideration as an environmentally sound, non-invasive; yet reusable alternative to fulfil MHM needs in populous countries such as India”

- Achuthan et al., 2021

Reference: <https://www.saukhyampads.org/>



Reference: <https://iopscience.iop.org/article/10.1088/1757-899X/377/1/012039/pdf>

CONCLUSION

Interventions we have taken towards this growing problem that have been productized and commercialized:

Reusable Banana Fiber Sanitary Pad (BFP)



Saukhyam Reusable Pad

- 01** The project was lauded at **UN Climate Change Conference (2018)** in Poland for its sustainable financing mechanism.
- 02** Saukhyam Reusable Pads were honored with **Most Innovative Product Award (2016)** by the National Institute of Rural Development, India.
- 03** In 2020, the Saukhyam team was recognized as the **Social Enterprise of the Year** for its "exceptional impact, clarity and growth of work dedicated to furthering the **UN Sustainable Development Goals**" from the Women for India and Social Founder Network coalition.

Reusable Sanitary Pad Cleaning Machine

Amrita team have developed a machine to automate the banana fiber cleaning process. The machine eco friendly and which have the impact on sustainable goals and rural economy.

