

## CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA



## SUDrain

- Phnom Penh, Cambodia
- Environmental services
- sudrain.com
- Analysis period: 2018-2024

## Coconut Fibre for Decentralised Wastewater Treatment

## Business Spotlight

SUDrain uses coconut fibres, traditionally a waste from coconut processing, to produce a biofilm material that is suitable for small scale, decentralised, wastewater treatment in Cambodia. This is an appropriate niche solution as 80% of wastewater in urban areas like Phnom Penh remains untreated, and rural clean water access in Cambodia is limited to 20%. The SUDrain system removes up to approximately 90% of pollutants and bacteria from the wastewater. Coconut fibre is a renewable and widely available waste material in Cambodia, and its conversion into a biofilm for wastewater treatment exemplifies the principles of resource circularity and resource substitution.

SUDrain provides consulting, system design and installation, along with water quality analysis for various customer segments. The system can be integrated with a simple drain, keeping the investment cost low and making SUDrain an affordable wastewater solution for Cambodia. Current efforts are focused on niche applications for safe sanitation in floating villages as well as for individual dwellings or detached tourist villas. Looking ahead, SUDrain aims to expand its operations, enhance its capacity to meet increasing demands, extend its market reach, and invest in an own manufacturing facility.

## Keywords

Coconut fibre filters, Biomaterials, Decentralised wastewater treatment

## Innovation

Product/service design, End of life management, Resource circularity, Resource substitution



### Context and baseline

Inadequate wastewater treatment is common throughout Cambodia and has led to a critical lack of access to clean water while posing significant risks equally to public health as well as the environment. It is estimated that 80% of wastewater in the capital Phnom Penh is directly discharged into natural water bodies like Boeung Choeung Ek Lake. This problem is exacerbated during heavy rainfall, causing sewage overflow in low-lying areas. Rural regions are also affected to the extent that only about 20% of rural populations in Cambodia have access to clean water.

Thary Vorn, environmental engineer, founded SUDrain in 2018 to promote an innovative, eco-friendly decentralised wastewater management solution. The SUDrain system utilises a biological filter made from coconut fibres. Thary picked up this idea during her engineering studies in The Netherlands, and she was able to further develop and produce the filter after having won a startup competition in Cambodia. This helped to fund research into the most suitable biomaterials for effective wastewater filtration. Furthermore, SUDrain aims to use local materials and, whenever available, recycled materials for system construction such as bamboo for the floating toilets.

### Innovation

The SUDrain domestic wastewater treatment system is unique in its utilisation of coconut fibres as biofilters. The filter is small, eco-friendly and low-cost and can be installed directly in sewer outlets. Upon extraction from waste coconut shells from local coconut processing, the coconut fibres are treated to acquire properties that enhance the ability to remove various pollutants and bacteria such as E. coli, and other contaminants from wastewater, as well as to reduce biological oxygen demand (BOD) and chemical oxygen demand (COD).

The production of this fibre material involves adapting a machine typically used in husk composting by local farmers, that is tweaked to yield coconut fibres with a higher moisture content and better filtration properties.

Each wastewater treatment solution is customised to the specific application and client, and locally available materials and structures are incorporated to minimise both costs and material needs. The product range includes solutions for individual households as well as systems for communities, capable of treating up to 12 m<sup>3</sup> of wastewater per day.

In 2024, SUDrain introduced an affordable, adaptable solution specifically designed for needs of single dwellings with a treatment capacity of 1.5 m<sup>3</sup>/day. This is ideally suited for standalone applications, such as individual villas in a resort. Such a solution can offer significant advantages by eliminating the need for connecting pipelines, enhancing flexibility and reducing costs.

The domestic wastewater treatment systems are designed to last approximately ten years, provided the coconut filters are replaced every three to five years at a modest cost. The old filters can be composted with other organic waste which further contributes to circularity.



### Circular Economy impact

The low cost and low tech decentralised domestic wastewater treatment system of SUDrain is an example of a circular product, through the useful application of the previously discarded coconut fibres (resource circularity) and by using these renewable biomaterials to replace synthetic filter materials (resource substitution).

The positive effects of this treatment system were exemplified through the recent installation in a floating village with sewage treatment systems for the communities for the benefit of 700 residents (200 households) located at S'ang, Kandal Province along the Bassac River. The project was co-funded by WaterAid Cambodia and the Department of Rural Development of Kandal Province. This project involved installing four integrated systems of toilets, water storage, and wastewater treatment, capable of treating a total of 48 m<sup>3</sup> per day. The initiative not only employed compostable coconut filters, but bamboo was also used as a floating material, and solar energy powers the toilets lights. The filter offers efficient domestic wastewater treatment for long-term water-quality preservation and it improves

living conditions. In other projects, the treated wastewater is being repurposed for use in fish ponds and plantations.

This model is not only effective but also scalable and replicable in other communities, floating villages, and schools. In this regard, SUDrain is starting new collaborations with partners such as PLAN international and Oxfam for charitable projects to cover installation and implementation of sanitation systems in floating schools around the Tonle Sap Lake. Extending these types of projects in Cambodia can help hundreds of students to access safe sanitation, limit waterborne disease and enhance better adoption of safe hygiene behaviours, which also contributes to environmental awareness and biodiversity conservation in the region.

SUDrain estimates that the systems it has installed during 2021–2023 daily prevent approximately 84 m<sup>3</sup> of untreated wastewater from being discharged into the natural environment. This has improved life for around 1000 people, among them 60% women and 15% children.

## Business and market impact

SUDrain custom designs its systems to client requirements, constructs and installs treatment systems, and conducts post-installation water testing to ensure treatment efficacy. The system costs can be considered as low, starting at USD 450 for a household system with a daily capacity of 1.5 m<sup>3</sup>. Larger systems with a 6-12 m<sup>3</sup> daily treatment capacity, suitable for resorts and communities, require more complex installation and utilities, resulting in total costs of around USD 15,000.

SUDrain estimates that the potential market for this type of product is in the range of USD 20 million, of which the company realistically aims to capture around USD 1 million. In early 2024, the company signed a contract to equip a resort of 300 villas in Kampot with individual systems, which has a clear potential for further expansion in the tourism and hospitality market segment. In addition to being cost- and time-effective, the systems have low operation and maintenance requirements and do not require extensive piping.

More households have also expressed interest in the smaller system, as this can be implemented in limited space and is affordable for individuals.

Having officially registered as a company in 2023, SUDrain is now seeking external investments to secure and expand operations by growing its existing team, potentially acquiring its own fibre extraction machine, and setting up its own factory, potentially in Kampong Chhnang province. The company is

working on a growing cluster of projects located in the various provinces of Kampot, Kandal, Siem Reap or Sihanoukville and around Tonle Sap Lake Area.

## Stakeholders

SUDrain's journey has benefitted from collaboration with various stakeholders. Notable partnerships include working with WaterAid and the Cambodian Ministry of Rural Development on wastewater solutions for floating communities. The Ministry of Education also endorsed the floating schools' sanitation project. A USD 25,000 project was signed in early 2024 to equip one school in Siem Reap Province with the support of Plan International and Siem Reap Provincial Department of Rural Development. OXFAM also confirmed its future commitment.

Another aspect of the floating communities' projects that can be highlighted is the fostering of community ownership through operation and maintenance training by SUDrain and their support to the community leaders to manage their own sanitation project once it is handed over to them. These alliances have facilitated and funded project implementation and equally enhanced the credibility of SUDrain. The company has received multiple prizes and grants from various donors in Cambodia, including SmartSpark Program (2018), UNDP Youth CoLab (2020), Khmer Enterprise Startup awards (2022), the Swiss Development Cooperation Lafiya programme (2023) and the Impact Challenges at SEA award (2022). SUDrain has also been selected as part of the Top 100 Resiliency Solutions from over 740 applicants from 70 countries to participate in the 2024 QBE AcceliCITY Resilience Challenge in Hong Kong at the end of 2024.

## Implementation

As a startup, SUDrain faces challenges, notably in recruiting skilled environmental engineers in Cambodia. The current team, although efficient, is limited in capacity, which can be challenging when managing multiple projects. Financial constraints, a common hurdle for first generation entrepreneurs, also limit the company's operational scope particularly given the need for working capital for design and construction of the wastewater treatment systems.

Cambodia has developed and is implementing environmental regulations for wastewater management that stipulate the need for companies including micro, small and medium enterprises (MSMEs) to treat wastewater adequately before discharge. In practice, however, these obligations are rarely enforced, especially in rural areas. This lack of consistent and predictable implementation and

enforcement of environmental regulation hampers the widespread adoption of sustainable practices, including for wastewater treatment.

Moreover, MSMEs in Cambodia, including SUDrain, grapple with the challenges of financing for environment related investments. Access to funds for environmentally focused initiatives is limited for SMEs, with financial institutions often hesitant to invest in green technologies perceived as risky or unproven.

These challenges highlight the need for enhanced support systems in Cambodia, including better access to green financing, more robust regulatory frameworks, and increased capacity building in environmental engineering and sustainable practices.



## Takeaways

SUDrain's journey highlights the critical need for a behavioural shift in wastewater management, transforming the perception of wastewater treatment as a cost burden to that of an essential and valuable public health and environmental service. This shift is essential not only for companies but also at the community level, emphasising that sustainable practices in wastewater treatment can be eco-friendly, support public health and deliver economic value.

SUDrain demonstrates that innovative, low-cost solutions using local, renewable materials can significantly improve domestic wastewater management, particularly in underserved regions.

Moreover, the success of Thary Vorn, the founder of SUDrain, as a woman entrepreneur in a technical field, challenges gender stereotypes, often associated with the engineering sector in Cambodia. It also underscores the importance of diversity in driving sustainable innovation.



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