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PARTICIPATORY APPROACHES AS DRIVERS FOR SUSTAINABLE WASTE MANAGEMENT IN RURAL NEPAL

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ABSTRACT
Nepal has been facing waste management (WM) problems for many years, especially in cities, but also increasingly in rural areas. Improper treatment, lack of organisation and management of solid waste (SW) contributes to pollution and toxic emissions, which inflict harm to humans and the environment. This study discusses how solid waste management systems (SWMS) in rural areas of Nepal can be improved. Rural regions are dealing with profound sustainability challenges, among others rapid expansion of tourism and fast changing infrastructure. The theoretical part discusses SWMS terminology both on a general basis and in rural mountainous regions, where the practical part covers a case study with design concept and practices. Literature shows deficiencies of the entire SWMS in Nepal, for example in form of inadequate communication between the government and local stakeholders, including the lack of participation possibilities. This problem is met by applying a participatory design approach (PA) for designing a waste bin with local stakeholders in Lower Mustang, Annapurna Region, Nepal. The didactic aim of the study was to train design students to work in different countries. The project is part of a Nepal – Norway collaboration (SAMAJ – Transdisciplinary Education for a Sustainable Society) which exchanges Master students from design and planning from both countries.

Keywords: Solid waste management systems, participatory approach, stakeholder collaboration, rural mountainous area Nepal

1 INTRODUCTION
Currently, over 30 million people live in Nepal. The growth rate throughout the country is increasing rapidly, where 4 out of 5 people live in rural areas [1]. Before the outbreak of Covid-19, a sector analysis estimated that Nepal received over 1.17 million international tourists in the year of 2018. The most popular reasons for visiting are trekking, pilgrimage, mountaineering and leisure [2]. The large number of visitors have led to severe challenges for SWMS. Literature shows that rural areas with a high tourism rate are more vulnerable to be compromised by improper treatment of SWM [3]. Poorly managed infrastructure, technical support, finance, and lack of communication are some of the ongoing issues. Overfilled containers and landfills, including the lack of bins, contribute to the problem of littering and improper treatment of SWMS.
The following article discusses theory and practice to meet SWM in rural areas with a special focus on PA. Chapter 2 briefly addresses SWMS as a national issue in Nepal and presents background, policies, and SWM in the country. Chapter 3 explains challenges of tourism in rural areas of Nepal, while chapter 4 introduces the case study area. Chapter 5 presents the application of PA in the project with the design development. Design development, results and outcome of the waste bin is described in chapter 6. The concluding remarks in chapter 7 summarise the reflection from the first author, where chapter 8 present benefits and challenges in training students to work in diverse cultural settings by the second author. The case study that is represented in this paper is based on a review article and a design project report from 2022, undertaken by a singular student from the Industrial Design Course over a period of 5 weeks exchange to Nepal. A Master Thesis (MA) with continuation of the project is currently undertaken by the same student and first author, which is expected to be completed by June 2023. Comprehensive and selected parts form the project report and some details from the MA is therefore presented. Results,

design development, refinement, final product, PA sessions and extended material from the MA is therefore not detailed elaborated in this paper.

2 SOLID WASTE MANAGEMENT ISSUES

Municipal Solid Waste (MSW) and tourism waste (TW) in urban and rural areas are stated as a global sustainability issue. Improper treatment and disposal of SW can cause a range of issues. It can become a financial and economic threat and lead to environmental challenges [4]. Pecci, (2017) states that every landfill will eventually leak and contaminate the surroundings [5].

A strategic report from the World Bank (2021) estimates that Nepal generates 1.7 million tons of MSW annually, where over half of it is biodegradable waste [6]. In 2011 the Government of Nepal authorised the SWM Act 2068, where it is the government's responsibility to manage SW efficiently and systematically [7]. The act includes creating a healthy and clean environment by using the 3R's principle: reduce, reuse and recycle. However, research has revealed that this act has not been carried out and the strategy has failed. The issues occur in several stages, such as segregation at source, waste collection and transportation, waste processing, disposal, formal and informal recycling [8]. Academia, practitioners and local residents have suggested and even demanded changes to the current SWM strategy [9].

Burning waste, dumping waste at landfills or in rivers are according to CBS (2021) the three main SWM methods in Nepal, with the first method being the operating one in Muktinath [10].

3 TOURIST WASTE IN LOWER MUSTANG

Nepal offers a diverse landscape, wildlife and attractions that create great opportunities for the tourism sector. However, TW impacts the environment and generates more pollution, which creates a strain within the entire SWMS [11]. Hotels, shops, transportation, and other services contribute to increasing SW. Plastic bottles, cardboard and paper, food waste, containers and packaging are the most common components of TW in rural areas. Transferring stations, bus stops, parking spots and other tourist attractions have an increase of biodegradable and non-biodegradable SW [12].

The new waste bin aims to be installed at the transferring station in Muktinath. Members of the local committee including Muktinath' s two head chiefs decided in 2023 during a project presentation to start with the collection of one waste material. Results from field visits and material collection indicates that the most disposed item is plastic bottles, hence the proposed design solution is aimed to collect this material. Representatives from the village have requested a design solution that can be utilized and adapted for future expansions where a collection of separate units can be added to collect a range of different waste materials.

4 CASE STUDY INTRODUCTION

The case study and design intervention took place in Lower Mustang, located between the Tibetan Plateau in the North and South of the high Himalayan Mountains. Specific focus was on Ranipauwa, a village within the Mustang district. Ranipauwa is a hub for both trekkers and pilgrims as the famous Annapurna Circuit trek runs around the Annapurna-Himal. Trekkers and pilgrims generate income for the local residents, simultaneously the SW problems increase as shown in Figure 1.

Different design methods and tools were applied to discover, refine, understand, and define SWM issues in the village, including the development of a design concept by applying PA. Figure 2 shows the design phases from the 2022 project report, where Figure 3 shows the different methods and tools that were utilised in the project. The aim of applying PA as the main method is to meet the user's needs, generate ownership and facilitate empowerment to the involved stakeholders [13]. Creating overall ownership of the design is one of the most important aspects in PA, while participating in the design process fosters inclusiveness. The design and PA process are further described in the next chapter.

Figure 1. Waste Pit in the Ranipauwa village

Figure 2. Design Phases, (left). Figure 3. Applied design methods and tools, (right)

5 PARTICPATORY INTERVENTIONS

All participants that are affected by the design, such as local residents and stakeholders, were invited to be involved in the project at different stages. PA is a broad term that involves different approaches and methods, where inclusiveness, empowerment and communication are centralised in the process. By involving stakeholders into the design process an alignment of joint contribution is formed [14].

As part of the PA, formal and informal interviews where individual or group sessions were conducted. The aim was to gather insight about the current situation and to develop design concepts. Figure 4 shows one of the PA sessions where a representative from the mother's group evaluates provided materials. Figure 6 shows a group of local residents that participated in the project.

A design wishes, demands and requirement (WDR) list for the design features was developed based on feedback, interviews, surveys, questionaries, field visits and observations. The input from the local stakeholders provides guidance and knowledge about the surroundings, end users, collection systems, special needs, weather conditions e.g., which further leads to a sustainable solution. In this case a sustainable solution is not necessarily a fancy high-tech waste bin product, but rather a realistic, affordable and long-lasting product that aims to fit both the current situation and the possibilities of future expansions.

A conceptual design was developed based on the WDR list and in collaborations with stakeholders during the project. The first conceptual design is seen in figure 6. Design justification for this concept is excluded in this paper as it is the first idea and not the final design solution.

Figure 4. Mother's group representative, (left). Figure 5. PA session with residents, (right)

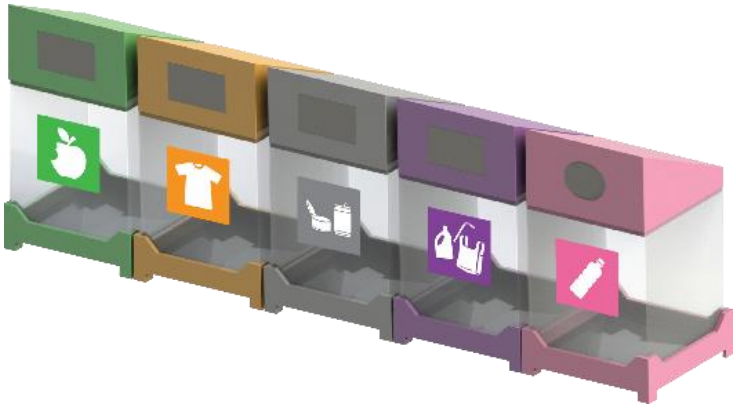

Figure 6. First design concept

6 DESIGN DEVLOPMENT AND RESULTS

The design development is adjusted and refined during the MA project. Several PA sessions with stakeholders have been carried out with great results, such as installing a 1:1 functional prototype in Muktinath. In addition, a PA session with a group of voluntary participants that represented the consumers were executed. A larger survey revolving graphical design content such as waste symbol icons and colour preference was performed during the MA, resulting in statistics about the most preferred waste symbol and colour. A proposed illustration of the product with separation of different waste materials is seen in figure 7. The design is based on multiple PA sessions, a WDR list, testing sessions, prototyping and refinement. A selection and summarised collection from the WDR list are seen in figure 8. A full and descriptive WDR list will be provided in the MA and possibly published online after the submission in 2023. It is advised to keep in mind that the design is aimed for rural areas and not developed countries. Figure 9 shows a 1:1 functional prototype, installed in Muktinath. Feedback collection, observation, testing and interviews were further executed. Inner waste bin bags are developed and designed based on local materials which can be recycled and reused. Collection method and retrieval of the waste is developed for easy collection. The infographic is designed to be self-explanatory, easy to understand regardless of nationality or language. It is also designed based on inspiring the consumers to compress the waste before disposal. This improves the amount of waste that can be collected and contributes to improved waste volume that can be stored in a storage unit before being sold or transported to external actors.

Figure 7. Proposed material collection and final waste bin design

Specification and feature	Justification
Fully enclosed compartment.	Avoid direct waste burning in the bin. Offer safe protection of collected waste.
Manufacturing cost cannot extend 20000 NPR pr. Unit.	Parts are designed with necessary materials and features.
The final product/material/parts must be suitable for transport including flat-packed options and be easy to assemble.	Transportation on dangerous and off-roads requires easy transport of materials or product parts.
Materials must be made with long-term sustainability features or coating.	Materials with long durability, low-militance, can withhold extreme elements and weather exposure is recommended.
The product must be self-explanatory, consumer friendly and inclusive.	Waste symbol/icon, colour recognition and infographic features are designed to be readable regardless of language barrier.
The product must offer expansion possibility of material collection.	Colour adaption, adjustable waste retrieval opening, and unified size is offered.

Figure 8. A WDR selection, (left). Figure 9. Installed functional 1:1 prototype, (right)

7 REFLECTIONS

Conducting PA in the field provides a deeper understanding of the current issues in rural areas of Nepal. The application of PA as primary research offers hard data that has not been processed by a second or third-party and provides substantial results. Collecting data, facilitating, advising, providing essential information and education are roles of the design student. Including providing a safe, trustworthy, reliable and inspiring environment for the participants. According to research, including PA in the design process offers a range of possibilities which contributes to a sustainable design solution. The design outcome is based on being a long-term solution for a specific rural location, whilst being adaptable and expandable to other rural regions of Nepal.

Parts of the design process revolved around advisement of feasible solutions to withhold the goal of being a sustainable design. Language barriers were a great challenge especially during the consultant session. Another challenge during the project was a reluctance to commit economically to improve the current SWMS, resolving in challenges of contribution and involvement from local actors. Being able to adapt and find creative solutions to these types of challenges is vital to sustain involvement, inclusiveness, empowerment, engagement and contribution to improvements. As a student reflection, PA is considered as one of the most valuable and important factors to provide a sustainable solution that fit a specific target group, location and withholds strict design requirements. Training and education were provided to certain groups revolving manufacture, maintenance, design assembly and waste collection. Additional advice regards separation, retrieval, safe storage unit expansions, transportation, waste value, places to sell the sorted waste, how to avoid and reduce waste burning, how to educate a larger consumer group, including education for local residents, was provided during PA sessions with the representative participants from the Ranipauwa village. This was executed as an addition and expansion of the project as the topic was highly relatable for what occurs to the waste after retrieval.

Continued collaboration with local residents and stakeholders is recommended to raise motivation for long-term improvements and to increase their sense of autonomy. It is important that they can contribute

with local attributes to these types of projects as it shows a willingness for improved environmental care, even if the current systems are lacking. Respecting and preserving cultural preferences and norms should be equally valuable. It should not be an aim to implement existing solutions found in other places, but rather to design a concept that is right for the rural areas of Nepal in contribution with the residents. Through PA a sustainable waste bin has been developed and installed in Muktinath.

8 CONCLUDING REMARKS

The goal of SAMAJ is to meet the SDGs with help of sustainable design for everyday in various cultural contexts. Applying insights from design theory in real-life allows students to apply and test participatory design methods, and experience how outcomes can vary. The findings of this article are practically implemented in a case study and project designing a sustainable WM solution. When designing for people in developing countries, design students can develop realistic expectations. Building relationships requires time, which is necessary to gain profound insights into stakeholders' and users' needs, and in local culture, values and traditions. This attempt is often acknowledged in a project, where participants report to feel empowered and heard, which in turn might increase their motivation to contribute. In this way, design for developing countries, educates 'reflective practitioners' [15] rather than mere 'problem-solvers'. 'Reflective practitioners' are characterised by achieving a balance between a design-led and research-led processes and between desirable, feasible and viable solutions [16].

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