

Floating Treatment
Wetland System
(FTWS)- Sustainable
green technology to
remediate polluted
surface water bodies



CRRP2021-11MY-P. Kayastha

2024



Project Reference Number: CRRP2021-11MY-P. Kayastha

Project Duration: 1 October 2021 - 30 September 2024 (3 years)

Funding Awarded: 78,000 USD

Grant DOI: <https://doi.org/10.30852/p.19914>

Date of Publication: 30 April 2024

Project Leader and Contact Details: Prof. Sadhana Pradhanang Kayastha, The Small Earth Nepal (SEN), Nepal (info@smallearth.org.np)

Collaborators and Contact Details:

- Dhiraj Pradhananga, Department of Meteorology, Tri-Chandra Multiple Campus, Tribhuvan University (TU), Kathmandu, Nepal, dhiraj.pradhananga@trc.tu.edu.np
- Deepak Aryal, Central Department of Hydrology and Meteorology, TU, Nepal, deepak.aryal@cdhm.tu.edu.np
- Rajesh Kumar, Central University of Rajasthan (CURAJ), India, rajesh.kumar@curaj.ac.in
- Soni Mulmi Pradhanang, University of Rhode Island (URI), United States, spradhanang@uri.edu
- Tadashi Toyama, University of Yamanashi (UY), Japan, ttoyama@yamanashi.ac.jp
- Towhida Rashid, University of Dhaka (DU), Bangladesh, towhida_rashid@yahoo.com
- Niranjana Bista, The Small Earth Nepal (SEN), Nepal, niranjana@smallearth.org.np
- Anoj Khanal, Kathmandu Valley Water Supply Management Board (KVWSMB), Nepal, geologistkhanal@gmail.com

Recommended Citation:

Kayastha S.P., Pradhananga D., Aryal D., Kumar R., Pradhanang S. M., Toyama T., Rashid T., Bista N., Khanal A. (2024). Floating Treatment Wetland System (FTWS) - Sustainable green technology to remediate polluted surface water bodies. Project Final Report. Asia-Pacific Network for Global Change Research (APN).



Asia-Pacific Network for Global Change Research (APN)

© 2024 The authors. Published by the Asia-Pacific Network for Global Change Research (APN) under the Creative Commons Attribution-NonCommercial 4.0 International (CC-BY-NC 4.0) licence.

All opinions, findings, conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of APN. While the information and advice in this publication are believed to be true and accurate at the date of publication, neither the editors nor APN accepts any legal responsibility for any errors or omissions that may be made. APN and its member countries make no warranty, expressed or implied, with respect to the material contained herein.

The use of geographic names, boundaries and related data on maps, and in lists and tables within this publication are not warranted to be error-free, nor do they imply any endorsement by APN.

Table of Contents

Abbreviations	5
1. Summary	1
2. Objectives.....	2
3. Outputs, Outcomes, and Impacts	3
4. Key Facts/Figures.....	6
5. Publications	7
5.1 Book Chapter.....	7
5.2 Guidebook.....	7
5.3 Policy Brief.....	7
5.4 Research Articles.....	7
6. Media Reports, Videos, and Other Digital Content.....	8
6.1 Newspaper Articles	8
6.2 Videos.....	9
6.3 News post of Project Activities.....	9
6.4 Radio Program in Nepal	11
7. Pull Quotes	12
8. Acknowledgments.....	13
9. Appendices.....	14
Appendix 1: Research.....	14
1.1 Microcosm Study.....	14
1.2 Field Prototype Installation.....	14
Appendix 2: Meetings and Workshops	16
2.1 Training Workshop	16
2.2. Project Planning and Training Workshop on Microcosm Experimental Setup and Water Quality Analysis	16
Appendix 3: Workshops	18
3.1 Community Workshop to Share and Interact with the Communities	18
3.2 Policy Workshop.....	20
3.3 Final Sharing Workshop of the Multi-country Collaborative Research on FTWS	20

Appendix 4: Community Awareness Activities	23
4.1 World Wetland Day celebration.....	23
4.2 Survey.....	24
4.3 Community Awareness Workshop on FTWS for Enhancement of Lake Water Quality (India)	24
4.4 Community Radio Programs	25
Appendix 5: Book Chapter and Journal Articles.....	26
5.1 Book Chapter.....	26
5.2 Journal Articles.....	26
5.2.1 Floating Treatment Wetland System in Nepal - Efficiency Analysis through a Microcosm Study.....	26
5.2.2 Evaluating Floating Treatment Wetland Systems for Water Quality Improvement: A Case Study of Nagdaha, Nepal.....	27
5.2.3 Linking the Science Communication with the Communities about Nature-based Solutions - A Case Study of Floating Treatment Wetland Systems (FTWS)	27
Appendix 6: Thesis Report	29
Appendix 7: List of Young Researchers	30
Appendix 8: Project Presentation in Workshops/Conferences.....	31

Abbreviations

AEPC	Alternative Energy Promotion Centre
AGU	American Geophysical Union
AMARC	World Association of Community Radio Broadcasters
APN	Asia-Pacific Network for Global Change Research
BCN	Bird Conservation Nepal
BOD	Biological oxygen demand
CREEW	Center of Research for Environment Energy and Water
CURAJ	Central University of Rajasthan
DO	Dissolved oxygen
DU	University of Dhaka
FTWS	Floating Treatment Wetlands System
INGO	International Non-Governmental Organization
KU	Kathmandu University
KVWSMB	Kathmandu Valley Water Supply Management Board
LMC	Lalitpur Metropolitan City
M.Sc.	Master's Degree of Sciences
NAST	Nepal Academy of Science and Technology
NbS	Nature-based solutions
NCRH	Nature Conservation and Research Hub
NGO	Non-Governmental Organization
NNWWW	Nepal National Water and Weather Week
NUC	Nagdaha United Club
SEN	The Small Earth Nepal
TU	Tribhuvan University
URI	University of Rhode Island
UY	University of Yamanashi
WfN	Wetlands for Nepal

1. Summary

Surface water bodies are vital for providing ecosystem services, serving as habitats for diverse organisms, and supporting various human needs. However, these water sources are increasingly degraded by pollutants, which adversely affect biodiversity, aquatic ecosystems, and human well-being. Therefore, it is crucial to remediate these polluted surface waters to restore ecosystems, conserve biodiversity, and enable water reuse for various purposes. Nature-based solutions (NbS), such as the Floating Treatment Wetlands System (FTWS), offer an effective and innovative approach to address these challenges. FTWS is a cost-effective phytoremediation method that enhances quality by using local plants and floating rafts to remediate polluted water bodies.

This study evaluated the practical implementation of FTWS at both microcosm and field levels. A microcosm experiment was conducted using a combination of monoculture and mixed culture plants under controlled conditions in a greenhouse chamber. Key water quality parameters were tested in the lab following the 23rd edition of the 'Standard Methods for the Examination of Water and Wastewater' published by the American Public Health Association in 2017. For the field-level study, floating rafts embedded with the selected plants were prepared and installed in lakes. The selected phytoremediation plants included *Canna indica*, *Cyperus alternifolius*, *Tradescantia pallida*, *Carex sp.*, and *Salvia splendens*, with *Canna indica* and *Cyperus alternifolius* proving most effective in water remediation.

Community members, local youth club members, and stakeholders were actively involved in the project, increasing their awareness of FTWS technology. The research graduates engaged in the study enhanced their skills in research and water quality analysis. Additionally, community workshops, policy dialogues, and surveys were conducted at the project sites to communicate the various aspects of FTWS to the community. A range of publications, including guidebooks, policy briefs, infographics, scientific research papers, project videos, science bulletins, and brochures, were developed. Community radio programs were also broadcast to share project information and broaden the project's impact. This project not only advanced scientific understanding but also significantly enhanced community engagement and awareness, promoting the adoption of NbS like FTWS for surface water remediation.

2. Objectives

The major objectives of the project were:

1. To test water quality for emerging contaminants, including nitrate and phosphate, as part of water analysis and remediation via FTWS.
2. To assess the capability of locally available plant species in the performance of FTWS contaminant removal.
3. To investigate the applicability of FTWS for lake restoration under various climatic conditions.
4. To generate protocols and technical guidelines on the design, construction, operation, and maintenance of FTWS at the field scale.
5. To communicate the study's outcomes to the relevant stakeholders and policymakers, raising awareness of existing water quality issues and innovative solutions.

3. Outputs, Outcomes, and Impacts

Outputs	Outcomes	Impacts
<p><i>Objective 1: To test water quality for emerging contaminants, including nitrate and phosphate, as part of water analysis and remediation via FTWS.</i></p>		
<p>-Water quality data for physiochemical parameters from three lakes in Nepal, India, and Bangladesh.</p> <p>-Eight graduate students gained hands-on experience in water quality analysis</p>	<p>-Provided insights into the remediation capacity of FTWS (using locally available plants) in both microcosm and field studies.</p>	<p>-Enhanced understanding of FTWS's potential for water remediation, with evidence supporting its use in other similar urban lakes.</p>
<p><i>Objective 2: To assess the capability of locally available plant species in the performance of FTWS to remove contaminants.</i></p>		
<p>-Locally available plant species (<i>Canna indica</i>, <i>Salvia splendens</i>, <i>Tradescantia pallida</i>, <i>Cyperus alternifolius</i>, <i>Carex sp.</i>) were tested at microcosm and field levels across Bangladesh, India and Nepal.</p> <p>-<i>Canna indica</i> exhibited excellent performance in all three countries, noted for its high biomass production and rapid growth.</p> <p>-<i>Cyperus alternifolius</i> also performed well in pollutant removal at both microcosm and field levels.</p>	<p>-Successfully assessed and recommended the capacity of selected plants for the remediation of surface water pollution in urban lakes.</p>	<p>-Provided a basis for the broader application of these plants in similar environments.</p>

<p><i>Objective 3: To investigate the applicability of FTWS for lake restoration under various climatic conditions.</i></p>		
<ul style="list-style-type: none"> -Field prototypes of FTWS were studied in three climatic zones: tropical, hot semi-arid, and tropical wet/dry. -Eight graduate students got hands-on experience in raft preparation and study -FTWS rafts contributed to lake beautification through blooming flowers 	<ul style="list-style-type: none"> -Demonstrated the capacity of FTWS for lake pollution remediation and plant survivability across different climatic zones. 	<ul style="list-style-type: none"> -Provided valuable data on the effectiveness of FTWS in diverse environmental conditions.
<p><i>Objective 4: To generate protocols and technical guidelines on the design, construction, operation, and maintenance of FTWS at the field scale.</i></p>		
<ul style="list-style-type: none"> -Produced a comprehensive guidebook detailing technical guidelines, design, construction, operation, and maintenance of FTWS. -Researchers and stakeholders gained access to FTWS guidelines for their use. 	<ul style="list-style-type: none"> -Facilitated the potential application of FTWS technology in other regions with similar conditions. 	<ul style="list-style-type: none"> -Enabled broader adoption of FTWS technology for urban lake remediation.
<p><i>Objective 5: To communicate the study's outcomes to relevant stakeholders and policymakers raising awareness of existing water quality issues and innovative solutions.</i></p>		
<ul style="list-style-type: none"> -Conducted three community workshops and three policy dialogues in Bangladesh, India, and Nepal. -Shared and disseminated project outcomes with stakeholders through various channels, including workshops, 	<ul style="list-style-type: none"> -Enhanced awareness among stakeholders (local communities, governments, policymakers, students, researchers, and the public) about wetland issues, FTWS technology, and the need for sustainable wetland management. 	<ul style="list-style-type: none"> -Stakeholders recognized the issues of water pollution and the potential solutions for its management, leading to evidence-based policy recommendations. -Government officials endorsed FTWS results for policy development in water resource conservation, with

community radio programs, and publications.		expressed interest in applying FTWS in Gundlav Pond and Hameer Pond in Kishangarh, India, and further collaborations in Nepal.
--	--	--

4. Key Facts/Figures

- **Water Quality Tests:** Conducted three comprehensive water quality tests on microcosm studies and floating rafts in Bangladesh, India, and Nepal.
- **Plant Species Tested:** Evaluated five locally available plant species - *Canna indica*, *Carex sp.*, *Cyperus alternifolius*, *Salvia splendens*, and *Tradescantia pallida* - for their pollutants remediation capacities.
- **Floating Rafts Installation:** Installed floating rafts made from locally sourced materials, such as bamboo, bamboo mats, and reusable waste like plastic bottles and styrofoam. The installations included:
 - 40 rafts (4 ft x 6 ft) in Nepal
 - 10 rafts (4 ft x 6 ft) in Bangladesh
 - 40 rafts (3 ft x 6 ft) in India
- **Capacity Building:** Provided hands-on training in water quality analysis to 8 graduate students. got hands-on knowledge of water quality analysis.
- **Workshops and Training:** Conducted 4 community workshops, 3 policy workshops, and 2 regional workshops (a project planning workshop and a final sharing workshop). These events engaged 578 participants, representing community members, students, and governmental and non-governmental organizations. Delivered 4 training sessions on water quality monitoring and raft construction during these workshops.
- **Community Engagement:** Raised awareness of FTWS among approximately 400 community members across Nepal, India, and Bangladesh through workshops.
- **Publications and Research:** Published one book chapter and have three research papers currently under review. Additionally, 1 guidebook, 2 brochures, 3 policy briefs, 1 infographic, 2 science bulletins, and 1 flyer were prepared.
- **Media and Outreach:** Generated 10 news articles covering project events, with 5 in Nepal, 4 in India, and 1 in the USA. Broadcast 8 community radio programs on FTWS, reaching an estimated audience of 1.3 million in Nepal.
- **Volunteer and Community Involvement:** Mobilized 15 volunteers for raft preparation and community surveys, with an additional 15 community members participating in various study activities in Nepal.
- **Project Website:** Developed and launched a dedicated project website, which is now operational.
- **Academic Achievement:** Supported the completion of a Master's thesis (M.Sc.) in Environmental Science at Tribhuvan University, Nepal.

5. Publications

5.1 Book Chapter

Singh, R., Sharma, A., Goswami, P., Pradhananga, D., Aryal, D., Pradhanang, S.M., & Kumar, R. (2023). Phytoremediation of Organic Contaminants: An Eco-friendly Approach-Based Application of Aquatic Macrophytes. In: Kumar, S., Bauddh, K., Singh, R., Kumar, N., Kumar, R. (eds) *Aquatic Macrophytes: Ecology, Functions and Services*. Springer, Singapore. https://doi.org/10.1007/978-981-99-3822-3_9 pp 175–205; Published: 23 November 2023; Publisher: Springer, Singapore: Print ISBN: 978-981-99-3821-6; Online ISBN: 978-981-99-3822-3

5.2 Guidebook

Byanju, A., Pradhanang, S. M., Pradhananga, D. (2024). Guidebook: Floating Treatment Wetland System (FTWS) (First). The Small Earth Nepal. <https://smallearthnepal.wordpress.com/wp-content/uploads/2024/05/ftws-guidebook.pdf> pp 1–21; Published: 31 May 2024; Publisher: The Small Earth Nepal, Nepal: Print ISBN: 9789937-1-6739-0; Online ISBN: 9789937-1-6740-6

5.3 Policy Brief

Byanju, A., Pradhananga, D. (2024). Policy brief: Management of Urban Lakes: Recommendations from Floating Treatment Wetland System (FTWS) project (Policy Brief) (First). The Small Earth Nepal. https://smallearthnepal.wordpress.com/wp-content/uploads/2024/04/ftws_policy-brief.pdf pp 1–25; Published: 10 April 2024; Publisher: The Small Earth Nepal, Nepal: Print ISBN: 9789937-1-6293-7; Online ISBN: 9789937-1-6277-7

5.4 Research Articles

- Byanju A., Pradhananga D., Basnet C., Pradhanang S.M. (2024). Floating Treatment Wetland System in Nepal - Efficiency Analysis through a Microcosm Study (under review)
- Byanju A., Pradhananga D., Pradhanang S.M., Dhungana B., Manandhar S., Maharjan A. (2024). Pilot study on the FTWS and evaluation of the surface water body of Nagdaha, Nepal, *Water Science and Engineering* (Submitted, and under review)
- Pradhananga D., Dhungana B., Byanju A., Maharjan A., Shrestha S. (2024). Linking the Science Communication with the Communities about Nature-Based Solutions - A Case Study of Floating Treatment Wetland Systems (FTWS) (Under submission)

6. Media Reports, Videos, and Other Digital Content

6.1 Newspaper Articles

Nepal

- **Featured on Kantipur Daily** with the title “The remediation of polluted water at Nagdaha” published on 22 December 2022.
<https://ekantipur.com/news/2022/12/22/16717130971642710.html>
- **Featured on Rising Nepal:**
 - Entitled “Man Made activities putting wetlands at risk” published on 3 February 2023.
https://risingnepaldaily.com/news/22244?fbclid=IwAR0Fja0UgsaakBj2-SGu1TEmZcVsJ4Zhh-ARLO6NbirCNxpHJEfLZ4w8k_4
 - Entitled “Stakeholders stress need to protect Nagdaha Lake” published on 29 November 2023.
[https://epaper.gorkhapatraonline.com/pdf/1326?file=%2Fuploads%2Ffile%2F2023%2F11%2Frisingnepal%2F2023-11-29-12-10-22-TRN-29Nov-01-\(1\).pdf&fbclid=IwAR0g6AFw5fc-LeeFWX-d6grA-98Ycan35Un0ojEcGZAFXzzRbu5z1Y9zceA](https://epaper.gorkhapatraonline.com/pdf/1326?file=%2Fuploads%2Ffile%2F2023%2F11%2Frisingnepal%2F2023-11-29-12-10-22-TRN-29Nov-01-(1).pdf&fbclid=IwAR0g6AFw5fc-LeeFWX-d6grA-98Ycan35Un0ojEcGZAFXzzRbu5z1Y9zceA)
- **Featured in Himalayan Times** with the title “Floating Treatment Wetland System remediating polluted surface water bodies” published on 23 January 2024.
<https://thehimalayantimes.com/environment/floating-treatment-wetland-system-remediating-polluted-surface-water-bodies>
- **Featured on Gothalo Khabar** with the title “Celebrated World Wetlands Day 2024 at Nagdaha, Lalitpur” published on 3 February 2024.
<https://english.gothalokhabar.com/news/detail/21536/>

USA

- **Featured on WIRED** with the title “Polluted Lakes Are Being Cleansed Using Floating Wetlands Made of Trash” published on 25 July 2024.
<https://www.wired.com/story/planet-pioneers-nagdaha-small-earth-nepal-soni-pradhanang-ftws-floating-treatment-wetland-systems-water-cleaning-pollution/>

India

- Clippings of FTWS newspaper articles on different project activities conducted by CURAJ published by various Indian newspapers
<https://drive.google.com/drive/folders/1ARfAQdcWvfgqxHrtxPK59GayWmKSFq0k>

6.2 Videos

- Overall FTWS project video uploaded on the SEN YouTube channel with the title “Remediation of surface water source through Floating Treatment Wetland System (FTWS)” on 31 May 2024. <https://www.youtube.com/watch?v=aQy8CF1l0ps>
- Raft preparation and installation video of Nepal featured in SEN YouTube channel with the title “Preparation and installation of Floating Treatment Raft in Nagdaha, Nepal” uploaded on 26 February 2023. <https://www.youtube.com/watch?v=Mq014tIWgBc>
- Community radio program broadcasted in Radio Sweta Shardul of Nepal featured in the SEN Youtube channel:
 - Episodes 1 and 2 with the translated title: Use of Floating Treatment Wetland System (FTWS) Technology for Nagdaha Conservation uploaded on 31 May 2024.
Episode 1: <https://www.youtube.com/watch?v=yvgyjXy9-Y> and
Episode 2: <https://www.youtube.com/watch?v=FGPhuXIVGVw>
- Project video prepared by CURAJ with all the activities conducted under the FTWS project that is saved in Google Drive.
https://drive.google.com/file/d/1n1A5_yPxP0LaHsyWtX6EWUwIHb8Dads2/view

6.3 News post of Project Activities

A. Capacity Building

- Entitled “Training Workshop on Water Quality Assessment and Monitoring” published on 5 April 2021.
<https://smallearth.org.np/activities/training-workshop-on-water-quality-assessment-and-monitoring/>
- Entitled “Project Planning and Training Workshop on Floating Treatment Wetland System” published on 5 May 2022.
<https://smallearth.org.np/activities/project-planning-and-training-workshop-on-floating-treatment-wetland-system/>
- Entitled “Training on Floating Treatment Wetland System (FTWS) Raft Construction” published on 14 November 2022.
<https://smallearth.org.np/activities/training-on-floating-treatment-wetland-system-ftws-raft-construction/>
- Entitled “Learning and Sharing Visit to the University of Dhaka, Bangladesh” published on 26 January 2023.
<https://smallearth.org.np/activities/learning-and-sharing-visit-to-university-of-dhaka-bangladesh/>

B. Project Implementation

- Entitled “Successfully Completed FTWS Rafts Installation in Nagdaha, Nepal” published on 22 December 2022.
<https://smallearth.org.np/activities/successfully-completed-ftws-rafts-installation-in-nagdaha-nepal/>
- Entitled “Replantation in Floating Rafts at Nagdaha Lake: A Step for Ecosystem Restoration” published on 18 October 2023.
<https://smallearth.org.np/activities/replantation-in-floating-rafts-at-nagdaha-lake-a-step-for-ecosystem-restoration/>

C. Knowledge Sharing and Outreach

- “SEN at Ninth National Conference on Science and Technology” published on 11 July 2022.
<https://smallearth.org.np/activities/sen-at-ninth-national-conference-on-science-and-technology/>
- “Formal Launch of the Installation of Floating Treatment Wetland System (FTWS) Rafts in Nagdaha Lake” published on 14 December 2022.
<https://smallearth.org.np/activities/formal-launch-of-the-installation-of-floating-treatment-wetland-system-ftws-rafts-in-nagdaha-lake/>
- “Bimonthly Progress Sharing of FTWS Project” published on 12 January 2023.
<https://smallearth.org.np/activities/bimonthly-sharing-of-progress-of-ftws-project/>
- “Celebration of ‘World Wetland Day 2023’ at Nagdaha, Lalitpur” published on 2 February 2023.
<https://smallearth.org.np/activities/celebrated-world-wetlands-day-2023-at-nagdaha-lalitpur/>
- “Enhancing Awareness of the Local Students and Communities: World Wetlands Day 2024 Observed at Nagdaha, Lalitpur” published on 4 February 2024.
<https://smallearth.org.np/activities/enhancing-awareness-of-the-local-students-and-communities-world-wetlands-day-2024-observed-at-nagdaha-lalitpur/>
- “Community Workshop on Floating Wetland Treatment System (FTWS) in Nagdaha” published on 6 November 2023.
<https://smallearth.org.np/activities/community-workshop-on-floating-wetland-treatment-system-ftws-in-nagdaha/>

- “Policy Workshop Conducted Under the Floating Treatment Wetland System (FTWS) Project” published on 29 December 2023.
<https://smallearth.org.np/activities/policy-workshop-conducted-under-the-floating-treatment-wetland-system-ftws-project/>
- “On-Site Interaction Meeting With the Community Radio Broadcasters for Radio Program on the Floating Treatment Wetland System (FTWS)” published on 16 April 2024.
<https://smallearth.org.np/activities/on-site-interaction-meeting-with-the-community-radio-broadcasters-for-radio-program-on-the-floating-treatment-wetland-system-ftws/>
- “The Final Sharing Workshop Concluded at the Central University of Rajasthan in India” also covering the MOU signing between SEN and CURAJ published on 28 February 2024.
<https://smallearth.org.np/activities/the-final-sharing-workshop-concluded-at-the-central-university-of-rajasthan-in-india/>

6.4 Radio Program in Nepal

- Community radio program broadcasted on Radio Sagarmatha’s Facebook page uploaded on 16 May 2024.
https://www.facebook.com/watch/live/?mibextid=qi2Omg&ref=watch_permalink&v=1485079215718528&rdid=KDFRIysrArt2b9iL

7. Pull Quotes

“As a graduate student in the FTWS project, I grabbed the opportunity to advance my skills, professionalism, and academic knowledge. The project has significantly enhanced my interpersonal skills regarding communication, research paper writing, program coordination, and project handling”.

Ms. Ayaswori Byanju, Research Graduate/Research Assistant, Nepal

“Eco-friendly technology like FTWS (with its successful results) can be replicated in many other lakes and ponds of Kathmandu/Lalitpur for their conservation and management”.

Mayor Chiri Babu Maharjan, Policy maker, Nepal

“SEN constantly informed and shared every aspect of the FTWS project, its progress as well as its results with our different women's groups of Nagdaha and the community. We, the members of the women's group, are delighted to be part of the project activities and to witness the beautiful flowers in the lake”.

Mrs. Kamala Mali, Community member, Nepal

“Floating treatment wetlands: where nature's beauty meets wastewater's solution.”

Prof. Rajesh Kumar, Professor/Collaborator, India

“I am very proud to attend the APN community workshop and APN Policy workshop. It was knowledge enhancing on eco-friendly methods for water purification. Looking forward to continued efforts in improving lake water quality in Kishangarh and Ajmer, India”.

Amar Singh Rathore, Chief Warden/a local trainee, India

"Effective collaboration among researchers, policymakers, and community members in Bangladesh, India, Japan, Nepal, and the USA was instrumental in the success of the FTWS project. Together, we've demonstrated that this innovative technology can significantly improve water quality in urban environments while empowering local communities".

Dr. Dhiraj Pradhananaga, UNESCO Chairholder in Mountain Water Sustainability/Collaborator, Nepal

8. Acknowledgments

We express our sincere gratitude to APN for financial support for the project. Our sincere thanks to the Lalitpur Metropolitan City (LMC), Ward No. 24., Nagdaha Conservation Committee, Nagdaha Football Club, United Youth Club, Shree Shakti Mahila Samuha, World Association of Community Radio Broadcasters (AMARC International) and community radios (Newa FM, Radio Jansanchar, Radio Paryawaran, Radio Sagarmatha, Grace FM, Sweta Shardul FM) of Nepal.

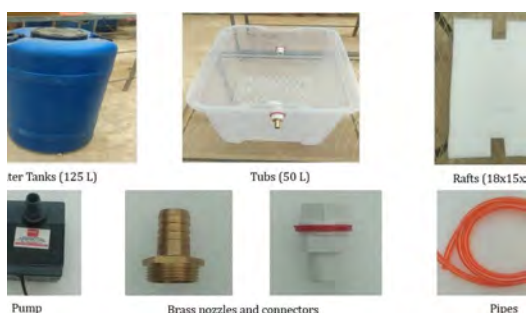
We express our honest gratitude to the Kathmandu Valley Water Supply Management Board (KVWSMB, Nepal), Center of Research for Environment Energy and Water (CREEW, Nepal), Nepal Academy of Science and Technology (NAST), and Environmental Lab of the Department of Geography and Environment, University of Dhaka (DU) for providing lab space and equipment for water quality test. We express our heartfelt gratitude to honourable Prof. Anand Bhalerao (Vice Chancellor, India), Professor Dr. Sirajul Haque (Department of Soil, Water, and Environment, Bangladesh), Dr. Amit Kumar Maharjan, University of Yamanashi (UY), Mr. Chiri Babu Maharjan, Mayor of Lalitpur Metropolitan City, Dr. Madan Lall Shrestha (NAST), Dr. Anusuya Joshi, Alternative Energy Promotion Centre (AEPC), Nepal, Dr. Pramod Kumar Jha, Professor emeritus, Tribhuvan University (TU), Nepal, and Mr. Bhawani S. Dongol (SEN) for their valuable contributions. We sincerely thank all the stakeholders, including community leaders, government officials, NGOs, academic professionals, researchers, volunteers, and social workers, who have extended their support and enthusiasm for the project.

9. Appendices

Appendix 1: Research

1.1 Microcosm Study

A microcosm study was conducted (Nepal: December 2021 to February 2022; India: October 2022 to January 2023; and Bangladesh: August-October 2022) by setting an experimental setup within a greenhouse-type shed. The microcosm experiments were carried out to investigate the efficacy of plant species both in monoculture and mixed culture setups. The study revealed the average efficiency of reducing the major pollutants like phosphates, nitrates, and ammonia from the lake water up to 95%, 99%, and 74% respectively in the project countries.



Different materials used for the preparation of microcosm setup in India

Microcosm setup with different treatment unit inserted with plants in Nepal



Microcosm setup with different treatment units inserted with plants in Bangladesh

A glimpse of the microcosm setup of India with different treatment units

1.2 Field Prototype Installation

Prototypes of the floating rafts were installed and monitored in (Nepal: December 2022 to March 2023); India: September 2023 to January 2024; and Bangladesh: February-May 2023) three lakes; Nagdaha, Nayagoan, and Dhanmondi lakes respectively. The floating rafts (prepared with locally available materials like bamboo frames, bamboo mats, and reusable trash materials like plastic bottles, polyethylene foam, and styrofoam) were inserted with the phytoremediation

plants and then installed in the respective lakes. The raft installation aimed at remediating the lake water, checking the survivability of the plants in an open environment, raising awareness in the community about the technology, and knowing the beauty provided by plants to the lake. The study showed a decrease in nitrate levels by 55 mg/l, and phosphate levels decreased from 1.4 mg/l to 0.1 mg/l after 60 days of study in CURAJ. Plant species like *Canna indica* survived the open environment while plant species like *Salvia splendens* didn't survive. The community members became aware of FTWS technology and the lake was beautified by the flowers of the *Canna indica* plants when they bloomed.



Preparation of raft inserted with plants for installation by DU team in Bangladesh



Installed rafts in Dhanmondi lake, Bangladesh



CURAJ team members inserting the plants in the raft before installation in India



Installed rafts in Nayagaon Talai, India



SEN team and community members inserting plants in the rafts before installation in Nagdaha, Nepal



SEN team member installing the rafts in Nagdaha, Nepal with the help of the community member

Appendix 2: Meetings and Workshops

2.1 Training Workshop

A training workshop was conducted on 2 April 2021 on water quality assessment and monitoring under the FTWS project at KVWSMB by SEN. The workshop aimed to train the research graduates, students, and collaborators of Nepal about the sampling methods as well as the water quality test. Dr. Sadhana Pradhanang Kayastha (Principle investigator, FTWS) highlighted the importance of water quality assessment as well as monitoring and discussing various factors affecting water quality for water-related research projects. Dr. Anusuya Joshi (Senior environmental and social safeguard expert at AEPC) explained appropriate statistical tools for data analysis, interpretation, and visualization. Participants grabbed detailed knowledge about the water quality test, sampling methods, needs, and process of data analysis through the training. The participants also visited the laboratory of KVWSMB and the experimental site to learn more about the techniques and equipment for water quality tests.



All the participants of the training workshop posing for a group photo after the training at the premises of KVWSMB



All participants visiting the lab of the KVWSMB as a part of training

2.2. Project Planning and Training Workshop on Microcosm Experimental Setup and Water Quality Analysis

A two-day regional workshop entitled ‘Project Planning and Training Workshop on Microcosm experimental setup and water quality analysis’ was organized at KVWSMB and the Hotel Akama, Kathmandu respectively in the presence of all the national and international collaborators including the representatives from the APN, CREEW, CURAJ, DU, KVWSMB, NAST, TU, URI, and UY. The workshop aimed at exchange and interaction about the project activities.

The 1st day of the workshop held on 28 April 2022 at KVWSMB aimed at introducing the collaborators and discussing FTWS project activities. The participants discussed the FTWS project and visited the experimental setup established at the premises of KVWSMB, Bhaishepati, Lalitpur. The second-day program focused on planning, knowledge sharing, and discussing the potential of the FTWS project with the collaborators and the participants. The participants got various insights into the FTWS project, including the technical details for the raft preparation,

FTWS project execution, and training on water quality analysis from the experts. The collaborators experienced the FTWS activities being conducted in Nepal, discussed each detail about the FTWS technology, and exchanged experiences, plans, and knowledge about the project for ways forward in other project countries.



Participants, collaborators, and guests posing for a group photo during the FTWS workshop at the Hotel Akama, Kathmandu



Participants visiting the FTWS microcosm experimental setup at the premises of KVVMB, Kathmandu

Appendix 3: Workshops

3.1 Community Workshop to Share and Interact with the Communities

Community workshops were conducted in Nepal: 3 November 2023; India: 31 October 2023; and Bangladesh: 6 March 2023 to share the project activities, outputs and raise awareness among community members and stakeholders regarding the implementation of FTWS in project countries. The events witnessed an overwhelming turnout, with approximately 150 attendees in DU (including the policy workshop), 32 participants in Nepal, and 74 participants in CURAJ including residents from the surrounding areas and volunteers, students, teachers, and stakeholders.

The workshop served as a platform for attendees to actively engage in discussions and gain valuable insights into the FTWS technology along with its potential impact on addressing water pollution in selected lakes. Participants exhibited a significant level of curiosity and eagerness to learn more about the innovative approach. Presentations delivered by experts and researchers provided comprehensive information on the importance of FTWS, highlighting its effectiveness in improving water quality and enhancing the ecological health of lake ecosystems. Attendees had the opportunity to get the overall information about the FTWS project and observe the functional aspects of the rafts.

- The full report of the community and policy workshop organized by DU:
<https://docs.google.com/document/d/1s1dQamQ9nt6BCcSAp-yiPJ9e8Lrze0kb/edit>
- The full report of the community workshop organized by CURAJ:
<https://drive.google.com/file/d/1w5rTAGgcLhGGXZUqqklfM3eVZ-QIaKJP/view>



Ms. Ayaswori Byanju presenting about the FTWS project outputs with the community members during the community workshop at Nagdaha, Nepal



Participants posing for a group photo after successful completion of community workshop at Nagdaha, Nepal



CURAJ team members interacting with community members during community workshop in India



Mr. Vipin Garg providing hands-on training on water quality assessment during community workshop in India



Dr. Towida Rashid demonstrating rafts to the community members during the community & policy workshop in Bangladesh



Participants during the community & policy workshop in Bangladesh

3.2 Policy Workshop

Policy workshops were conducted in Nepal: 28 November 2023; India: 31 January 2024 and Bangladesh: 6 March 2023 to disseminate results, project activities, and achievements among policymakers especially with participants from relevant government and non-government organizations, NGOs, INGOs, and researchers in project countries. The FTWS project was discussed with a diverse group of participants and their suggestions, feedback, and some policy recommendations were collected to prepare the policy brief.

In total, 39 individuals participated in the workshop in Nepal and 26 in India. The workshops successfully created awareness and secured commitments to future collaboration in nature-based activities from the participants representing both governmental and non-governmental bodies.

- The full report of the policy workshop organized by CURAJ:

<https://docs.google.com/document/d/1QuS-DsSsHQIKgIbiGW6rSa5JZPMD7xB8/edit>



Participants posing for a group photo at the policy workshop in India



Participants discussing on sustainable wetland management during a group work at the policy workshop in Nepal

3.3 Final Sharing Workshop of the Multi-country Collaborative Research on FTWS

The final sharing workshop was conducted at CURAJ, India on 22-23 February 2024. was attended by collaborators from DU, CURAJ, TU, and SEN along with professors, students, and officials from CURAJ. The workshop facilitated the exchange of knowledge, experiences, and best practices among researchers, practitioners, policymakers, and stakeholders involved in FTWS research and implementation across multiple countries. The workshop was specifically crafted to understand the benefits and challenges associated with FTWS in remediating polluted surface water bodies in diverse geographical and environmental contexts. The workshop facilitated productive discussions on FTWS and its design, functionality, and ecological benefits in all three countries.

The project collaborators from Nepal, India, and Bangladesh provided an overview of their region's research progress, outputs, challenges, and successful case studies. The project's

process, progress, and outcomes were presented by Mr. Abir Mahmud and Ms. Munira Nusrat (DU) from Bangladesh, Dr. Rajesh Kumar (CURAJ) from India, Ms. Ayaswori Byanju (SEN), and Dr. Dhiraj Pradhananga (TU/SEN) from Nepal. Participants delved into topics such as plant selection, system design, and performance monitoring during interactive sessions. These sessions aided in detailed discussions and facilitated networking among participants with similar interests.

One of the major outcomes of this project has been the formal Memorandum of Understanding (MOU) between SEN and CURAJ for further collaboration with a focus on research and capacity building in the region. SEN and CURAJ exchanged the MOU in the presence of Prof. Anand Bhalerao, Vice Chancellor of CURAJ, and Dr. Dhiraj Pradhananga, President of SEN with faculty members of CURAJ and the collaborating members from Nepal. This is a milestone achieved with the support from APN in enhancing and extending collaborations amongst the regional partners.



Dr. Rajesh Kumar presenting about the project activities of the CURAJ team representing India



Dr. Sadhana Pradhananag, briefing about the FTWS project at the workshop



Ms. Ayaswori Byanju presenting the project activities of the SEN team representing Nepal



Ms. Munira Nusrat and Mr. Abir Mahmud presenting the project activities of the DU team representing Bangladesh



Collaborators posing for a group photo in front of the program banner



All the participants posing for the group photo after the completion of the workshop

Appendix 4: Community Awareness Activities

4.1 World Wetland Day celebration

World Wetlands Day 2023 and 2024 were celebrated at Nagdaha, Nepal led by SEN. It was attended by scholars, researchers, local stakeholders, students, conservationists, and representatives from Lalitpur Metropolitan City, Ward No. 24. The program enhanced knowledge, awareness of wetlands and their conservation. The program also highlighted the importance of NbS (like FTWS) for the conservation and restoration of Nagdaha through presentations and documentary shows. Various organizations like Wetlands for Nepal (WfN), Nature Conservation and Research Hub (NCRH), Nagdaha United Club (NUC), and Bird Conservation Nepal (BCN) were a part of this program. Discussions on sediment retention systems, lake water purification measures through FTWS rafts, and other restoration measures were held. An art competition was also conducted amongst the school students to improve their understanding of wetlands, FTWS, and their interconnection with the environment, biodiversity, society, culture, and human well-being.



Dr. Dhiraj Pradhananga presenting on importance of wetlands conservation during the World Wetland Day 2023 celebration at Nagdaha



Participants posing for a group photo after World Wetland Day 2023 celebration at Nagdaha



Participants posing for a group photo at the end of World Wetland Day 2024 celebration at Nagdaha



Students drawing for an art competition during the World Wetland Day 2024 celebration in the premises of Nagdaha

4.2 Survey

A community survey was conducted from 21-30 August 2023 by SEN at Nagdaha, Nepal. The survey aimed to analyze the level of knowledge and understanding of community members on FTWS technology. The objective of the survey was also to clear doubts and misunderstandings about the FTWS among the community members and to communicate the exact science behind the technology to further prevent any misinterpretation. A questionnaire survey was done with the local community members and stakeholders within a radius of 350 meters from the center of Nagdaha. The survey was conducted in 104 households out of 521 households, inside the selected zone, and showed that 88% of the respondents were familiar with the installation of floating rafts in Nagdaha but had very few concepts about the technology behind it. 74% of the respondents knew about the beautification purpose of the floating rafts. The survey helped the communities to have a better understanding of the technology.



Surveyors conducting a questionnaire survey with community members at Nagdaha



Surveyors conducting a questionnaire survey with community member at Nagdaha

4.3 Community Awareness Workshop on FTWS for Enhancement of Lake Water Quality (India)

FTWS community awareness workshop was organized by CURAJ for the enhancement of lake water quality on 17 May 2024 with 83 participants. The workshop started with a brief overview of the FTWS project background and objectives for the participants. Training on water quality parameters was provided to the participants about physical, chemical, and biological parameters. Hands-on training was also provided on assessing the water quality parameters to characterize the water. The training was followed by live demonstrations of assessing pH, electrical conductivity, total dissolved solids, alkalinity, acidity, salinity, and hardness parameters. Finally, a discussion and feedback session was conducted with the participants, including the local community and environmental enthusiasts.

- The full report of the community awareness workshop organized by CURAJ: https://docs.google.com/document/d/1Jx9Z_GXGOZk0HahK-Ju1HFTR25mie0xy/edit



Dr. Rajesh Kumar presenting on FTWS project during the community awareness workshop, CURAJ



Participants posing for the group photo during the workshop, CURAJ

4.4 Community Radio Programs

In Nepal, community radio programs were broadcasted during May-June 2024 through various community radios to disseminate knowledge about FTWS technology and raise awareness among the different communities. The main motive of the program was to spread information about the FTWS project being done in Nagdaha, Nepal, among a large audience of different communities through six community radios; Radio Sagarmatha, Newa FM, Janasanchar FM, Grace FM, Radio Shweta Shardul, and Radio Paryabaran in Kathmandu Valley. The radio programs were successful in disseminating knowledge about different aspects of FTWS and Nagdaha among approximately 1,300,000 people.

- The full report of the community awareness radio program entitled as “Public awareness through the community radio programs on the Floating Treatment Wetland System (FTWS).

<https://docs.google.com/document/d/1HRnib7vwxlCsaSGs-pQUqCrk654NDJ6M/edit>



Ms. Supriya Rai, presenter of Radio Shweta Shardul presenting radio program on FTWS for community awareness



Community members and the SEN team interacting during the interaction workshop at Nagdaha

Appendix 5: Book Chapter and Journal Articles

5.1 Book Chapter

Abstract: *Environmental pollution is a serious global issue that threatens public health and the well-being of living beings. Unmatched pollution in aquatic ecosystems necessitates environmentally acceptable, long-term remedial technologies. One of the most effective strategies among the numerous ones implemented so far for environmental remediation is phytoremediation. It is a low-cost, eco-friendly, and long-term method which uses hyperaccumulator plants to convert and/or stabilize the pollutants in soil/water matrices. In recent years, aquatic macrophytes have gained significant attention in the field of environmental cleanup. Aquatic macrophytes are the key component of wetlands that have a substantial impression on ecosystem functions and services. This chapter gives an overview of the aquatic macrophytes and outlines the recent progress made in the use of macrophytes for the remediation of various organic contaminants. In addition, artificial wetlands, their types, and their role in wastewater treatment have been discussed.*

Keywords: Environmental pollution, Phytoremediation, Aquatic macrophytes, Organic contaminants, Constructed wetlands, Floating wetlands

5.2 Journal Articles

5.2.1 Floating Treatment Wetland System in Nepal - Efficiency Analysis through a Microcosm Study

Abstract: *Many lakes and ponds in Nepal suffer from nutrient enrichment due to pollutant runoff and seepage. Eutrophication of surface water bodies is one of the major nutrient pollution problems globally. Remediation is often technically and economically challenging. FTWS is a sustainable eco-technology that could be used to remediate polluted water by removing pollutants from water using phytoremediation plants supported by floating rafts. An experiment with different sets of microcosm treatment units was set up at the KVWSMB office in Lalitpur, Nepal. Each treatment unit had *Canna indica* and *Tradescantia pallida* either placed separately or in combination. Water samples were tested in the laboratory. The efficiency of FTWS in treating polluted water was then quantitatively analyzed before and after treatment the percentage removal of nutrients and increase in dissolved oxygen (DO). Around 99% of $\text{NO}_3\text{-N}$, 54% of $\text{NH}_4\text{-N}$, 91% of $\text{PO}_4\text{-P}$, and 56% of iron were removed from the sample taken from Nagdaha, an urban lake at Lalitpur, Nepal. Biological oxygen demand (BOD) decreased by 41%, and DO increased by 50%. The *Canna indica* unit and the unit with a combination of *Canna indica* and *Tradescantia pallida* were statistically significant with a *p*-value less than 0.5 in removing nutrients among all microcosm setups.*

Keywords: Floating Treatment Wetland System, eutrophication, microcosm experimental setup, bioremediation

5.2.2 Evaluating Floating Treatment Wetland Systems for Water Quality Improvement: A Case Study of Nagdaha, Nepal

Abstract: *Population growth and agricultural practices, excessive nutrients, and pollutants increasingly threaten surface water bodies and ecosystems. Numerous technologies are being developed to treat polluted water in a sustainable approach. FTWS is one of the nature-based remediation technologies consisting of a floating raft that supports phytoremediation plants, allowing roots to be suspended in the water column to remediate different pollutants from water. The study was conducted in Nagdaha, Lalitpur to test the efficacy of FTWS in remediating polluted surface water. For this, 40 floating rafts of 4 X 6 ft. (24 sq. ft.) each were constructed and planted with *Canna indica* and *Salvia splendens* that were strategically deployed on the lake at five different points with each point consisting of eight rafts. Water quality parameters (nitrate, ammonia, phosphate, iron) were monitored at all the installed points including inlet and outlet of the lake. During the five-month test period, the maximum nitrate reduction was 94% in the rafts installed at the northeast point while the maximum iron reduction was 95% in the southeast points. In the case of ammonia, the maximum reduction was found to be 68% at the southwest point compared to the lake inlet. Statistical analysis revealed a significant difference ($p < 0.05$) only for nitrate concentration between inlet and outlet points, suggesting minimal impact on other parameters. The study indicated better survival of *Canna indica* compared to SS, and floating rafts with *Canna indica* enhanced the scenic beauty of the lake after blooming.*

Keywords: Floating Treatment Wetland System (FTWS), floating rafts, Nagdaha, phytoremediation, nature-based remediation technology

The link to the manuscript entitled “Evaluating floating treatment wetland systems for water quality improvement: a case study of Nagdaha, Nepal”:

<https://docs.google.com/document/d/1kvlokM5saOG9suNDd4-J84sYjYUpiXBJrgVGga2Vhak/edit>

5.2.3 Linking the Science Communication with the Communities about Nature-based Solutions - A Case Study of Floating Treatment Wetland Systems (FTWS)

Abstract: *Nature-based Solutions (NbS) like the FTWS are a nature-friendly, low-cost, and effective remediation technology for removing pollutants from lakes. FTWS study was conducted in Nagdaha Lake in the Lalitpur district of Nepal. This research aimed to understand the effectiveness of science communication in the communities about FTWS through a community survey, using questionnaires. The project was initiated after the interactions, public consultation, and discussions with community members and stakeholders. Activities like community workshops, wetland day celebrations, and awareness programs were conducted to strengthen the knowledge and bridge the gap between the community and the science behind the FTWS technology. About 20% of 521 households within the 350-meter circumference of Nagdaha were considered for the survey. It was found that 88% of the respondents had seen the installed floating rafts in Nagdaha but didn't know about the technology. Meanwhile, 12% were*

completely unaware of the installation of FTWS technology in Nagdaha due to their rare visit to Nagdaha and having no relevance with Nagdaha for any purpose. The perception towards FTWS and its scientific linkage has been prominent with the participation of locals, surveying, and providing more resources for learning about the project. The study highlighted the importance and effectiveness of connecting the science of NbS to communities to promote public understanding, gain their support, and promote ownership of these approaches. Strong science community linkage was established by implementing the FTWS with the help of local communities and raising awareness through surveys and interactions.

Keywords: Community, Nature-based solutions, Science communication, Floating Treatment Wetland System (FTWS)

The link to the full paper entitled “Linking the science communication with the communities about Nature-based solutions - A case study of Floating Treatment Wetland Systems (FTWS)”: https://docs.google.com/document/d/1qT8uvGBm1src1LgKLQiM8wwbmeLeN4_5rt1ha02IVA/edit

Appendix 6: Thesis Report

Abstract: *Eutrophication of the water bodies is the most significant problem of surface water quality, which is the consequence of the nutrient pollutants in water. A FTWS is a sustainable, green, and simple technology that remediates polluted water through the removal of pollutants from water by the use of plants supported by floating rafts. The research was carried out to study the effectiveness of the FTWS in remediating the polluted water of the water body in Kathmandu. An experimental setup was prepared with the different sets of microcosm treatment units. Nagdaha at Dhapakhel, Lalitpur was selected as the study area. The water sample from Nagdaha was transported to the microcosm units of the experimental setup completed with the selected remediating plants *Tradescantia pallida* and *Canna indica* inserted in the floating raft prepared from polyethylene foam. The microcosm contained five treatment units. Each unit consisted of three buckets of 40 L capacity inter-connected with a 100 L drum with pipes for the circulation of water. Triplicate water samples were collected from each bucket once in 15 days for two months and parameters including dissolved oxygen, biological oxygen demand, ammonia, nitrate, ortho-phosphate, iron, electrical conductivity, and pH were tested in the two labs. The percentage removal was calculated from the experimentation results. The percentage removal of ammonia ranges from 40 to 80%, nitrate from 80 to 95%, ortho-phosphate from 85 to 95%, iron from 50 to 60%, and 80 to 96% increase in dissolved oxygen. Computing percentage removal provided insight into the effectiveness of FTWS in the successful remediation of water pollutants.*

Keywords: FTWS, wastewater treatment, water quality, eutrophication, microcosm experimental setup, bioremediation.

Appendix 7: List of Young Researchers

Young Scientist	Sex	Institute	Country	Contact detail
Abir Mahmud	M	DU	Bangladesh	abirmahmood89@gmail.com
Anjana Maharjan	F	SEN	Nepal	anjana.smallearth@gmail.com
Ayaswori Byanju	F	SEN/TU	Nepal	asoriebenju@gmail.com
Bharat Dhungana	M	SEN	Nepal	bharatsmallearth@gmail.com
Crish Basnet	M	SEN/KU	Nepal	crishbasnet108@gmail.com
Kajol Basnet	F	SEN	Nepal	kazolbasnet@gmail.com
Munira Nusrat	F	DU	Bangladesh	mn.priscilla15@gmail.com
Nazmoon Nahar Sumiya	F	DU	Bangladesh	sumiya.geoenv@du.ac.bd
Pallawi Sharma	F	SEN	Nepal	pallawime@gmail.com
Prashant Jaiswal	M	CURAJ	India	pkjmjk@gmail.com
Purnima Subedi	F	TU	Nepal	subedipurnima2076@gmail.com
Ranjit Chapagain	M	TU	Nepal	ranjitchapagai@gmail.com
Samyak Prajapati	M	SEN/KU	Nepal	samyak144@gmail.com
Smriti Shrestha	F	KU	Nepal	shresthasmriti30@gmail.com
Susa Manandhar	F	SEN/TU	Nepal	susa.smallearth@gmail.com
Tri-Bikram Basnet	M	SEN/TU	Nepal	basnettribikram@gmail.com
Vipin Garg	M	CURAJ	India	vipingargevs@gmail.com

Appendix 8: Project Presentation in Workshops/Conferences

Topic	Authors	Conference/workshop name	Date
An innovative Floating Treatment Wetland System (FTWS) using the Microcosm Study to Remediate Polluted Water of Nagdaha	Ms. Ayawori Byanju and Dr. Dhiraj Pradhananga	9th National Conference on Science and Technology organized by the Nepal Academy of Science and Technology (NAST)	28 June 2022
Floating Treatment Wetland System (FTWS) to remediate polluted waterbody	Ms. Ayawori Byanju and Dr. Dhiraj Pradhananga	Celebration of World Water Day with the theme 'Accelerating Change' under Nepal National Water and Weather Week (NNWWW)	22 March 2023
Phytoremediation using the Floating Treatment Wetland System in Nepal - Efficiency Analysis through a Microcosm Study	Ms. Ayawori Byanju and Dr. Dhiraj Pradhananga	AGU23 Wide Open Science Conference by the American Geophysical Union (AGU)	15 December 2023