Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 4 Issue 3 (2024)

AI-Powered Solutions for Sustainable Practices: The Impact of Arjun's Initiative on Campus Cleaning

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Abstract:

Green Valley University, India is a vibrant institution known for its commitment to academic excellence and innovation, attracting a diverse student body passionate about making a difference in the world. Nestled in a picturesque setting, the campus fosters a collaborative environment where students can explore their interests, engage in meaningful projects, and pursue sustainability initiatives that promote environmental stewardship. Arjun is a dedicated and passionate environmental science major at Green Valley University, known for his unwavering commitment to sustainability. Growing up in a family that emphasized the importance of nature and conservation, he developed a deep appreciation for the environment at an early age. His journey in college has been defined by his desire to create meaningful change, particularly in areas where awareness and action are desperately needed Arjun, a college environmental science major and a part-time canteen worker. Passionate about sustainability, Arjun notices the heavy use of chemical cleaners and high waste levels in the canteen. However, beneath the surface of this vibrant space lay a growing concern: the excessive use of chemical cleaners and disposable materials significantly impacted the environment and posed health risks to its users. While the canteen served thousands of meals daily, the ecological footprint it left behind was alarming. Recognizing the urgency of the situation, Arjun, a passionate environmental science major, felt compelled to take action.

Sustainability at Green Valley University:

Green Valley University, India, is a renowned institution celebrated for its commitment to academic excellence and innovation, with a strong emphasis on environmental responsibility. Set against a scenic backdrop, the university's campus not only fosters a sense of community and collaboration but also champions a culture of sustainability. This commitment permeates every aspect of campus life, inspiring students and faculty alike to engage actively in projects that prioritize ecological balance and social responsibility. Among its most frequented facilities, the university canteen stands as a bustling hub of activity, serving thousands of students and staff each day. However, this vibrant space has become emblematic of an underlying issue: a high reliance on chemical cleaning agents and single-use disposables, posing both environmental and health challenges.

Canteen setting and initial challenges:

The canteen's extensive daily operations lead to significant waste and pollution, largely driven by single-use plastics and strong chemical cleaners that leave residues and release airborne toxins. Students and staff frequently noted respiratory discomfort and allergic reactions, raising concerns about the health implications of prolonged exposure to these chemicals.

Additionally, the volume of disposable plastics contradicted the university's sustainability goals, contributing to an unsustainable ecological footprint that Arjun, a passionate environmental science major, found difficult to ignore.

Purpose of the initiative:

Driven by a deep commitment to conservation, Arjun took decisive action to address the environmental and health issues in the college canteen. He launched a project to replace harmful practices with eco-friendly alternatives, using AI to track progress. His mission: to transform the canteen into a model of sustainability for the entire campus. Inspired by the United Nations Sustainable Development Goals (SDGs), particularly Goal 12: Responsible Consumption and Production, he decided to spearhead a project to transform the canteen into a model of sustainability.

Objective/s of the case:

- To assess the effectiveness of eco-friendly cleaning products and practices in reducing environmental impact, improving air quality, and maintaining sanitation standards in a high-traffic college canteen.
- To explore how AI-driven data analysis can support sustainable practices by tracking resource usage, analysing impact, and providing insights for improvement.
- To showcase practical steps taken to reduce waste and promote responsible consumption and production in an institutional setting, in alignment with SDG 12.
- To determine the cost savings, efficiency gains, and staff satisfaction achieved through sustainable cleaning practices.

Plan:

Arjun assembled a team of like-minded students, including his roommate Lily, who was studying data analytics, and Maya, a culinary arts major interested in eco-friendly cooking. Together, they devised a two-pronged approach: reduce waste by adopting sustainable practices and replace harmful cleaning agents with eco-friendly alternatives. To facilitate this, they planned to use AI-driven data analysis to assess current waste generation and identify effective substitutes.

Timeline of Arjun's Initiative for Sustainable Cleaning in the College Canteen

Month 1 – Observation and Initial Research

Arjun notices excessive use of chemical cleaners and high levels of disposable waste in the canteen. He begins researching green cleaning alternatives, focusing on low-cost, effective options suited for a canteen setting.

Month 2 – Proposal Development

Arjun drafts a proposal outlining the benefits of sustainable cleaning solutions, emphasizing health, cost efficiency, and environmental impact. He schedules a meeting with the canteen manager to present his ideas.

Month 3 – Approval and Funding

After initial discussions, Arjun gets approval from the canteen management to conduct a pilot trial.He collaborates with the student sustainability club to secure minimal funding for initial supplies of eco-friendly cleaners and compostable tools.

Month 4 – Pilot Implementation and Training

Arjun organizes a workshop for canteen staff, introducing them to sustainable cleaning practices, such as using vinegar-based cleaners and enzyme solutions. He oversees the first month of the trial, collecting feedback from staff and making adjustments as needed.

Month 5 – Data Collection and Feedback

Arjun conducts surveys and informal interviews with the canteen staff and some students to assess the effectiveness and reception of the green cleaning solutions. He gathers data on reduced chemical use, cost savings, and any challenges encountered.

Month 6 – Full Implementation and Advocacy

With positive results from the pilot, the canteen management agrees to implement green cleaning solutions on a broader scale. Arjun expands his efforts by involving more students, organizing a campus-wide awareness campaign on the benefits of sustainable practices in food and dining areas.

Month 7 onwards – Ongoing Monitoring and Improvement

Arjun periodically checks in with the canteen staff and reviews sustainability metrics, ensuring continued effectiveness and exploring further improvements. Inspired by his success, Arjun plans to propose similar sustainable practices for other campus facilities, creating a long-lasting impact on the college's environmental footprint. This structured approach not only helps Arjun achieve his goals but also builds a framework for others to implement green practices in similar high-traffic areas.

Model diagram: Sustainable Cleaning Implementation in College Canteen

Inputs (Sustainable Products, AI Tools, Resources) →

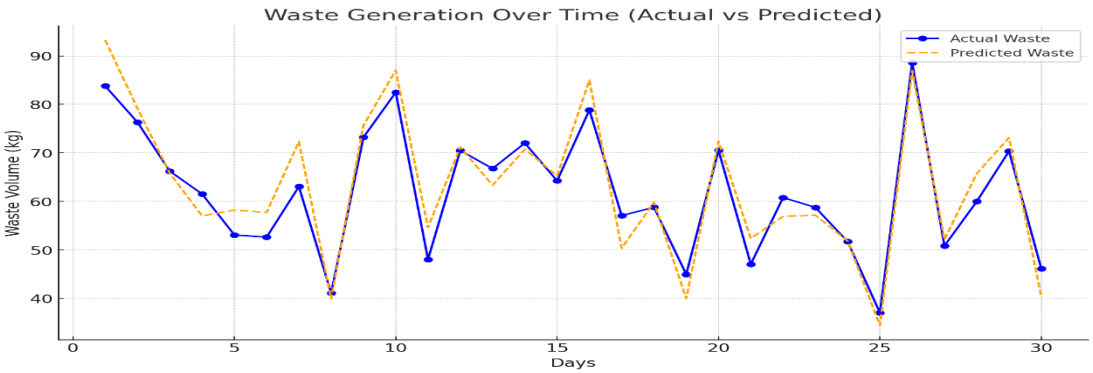
Processes (Baseline Analysis, Implementation, Training, AI Monitoring, Adjustments) →

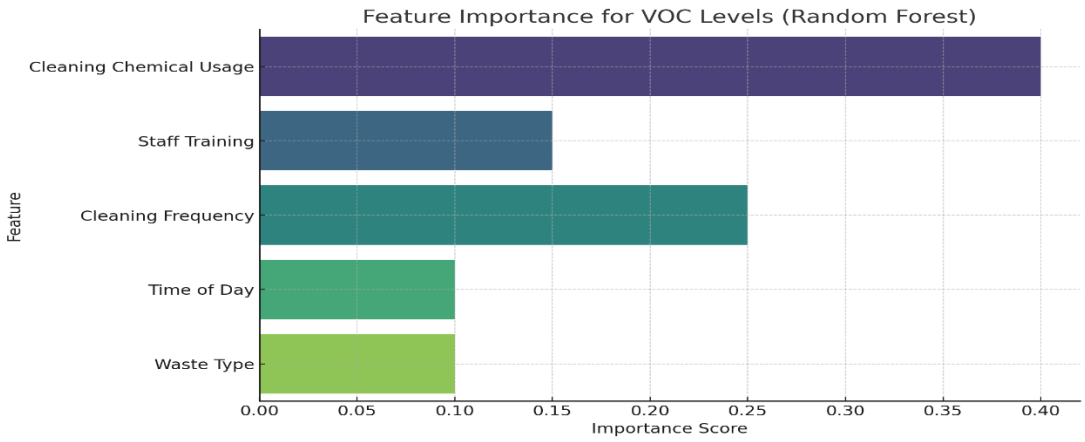
Outputs (Reduced Chemicals & Waste, Cost Savings, Improved Air Quality, Satisfaction) -→

Outcomes (SDG Alignment, Sustainability Culture, Cost Efficiency, Scalability)

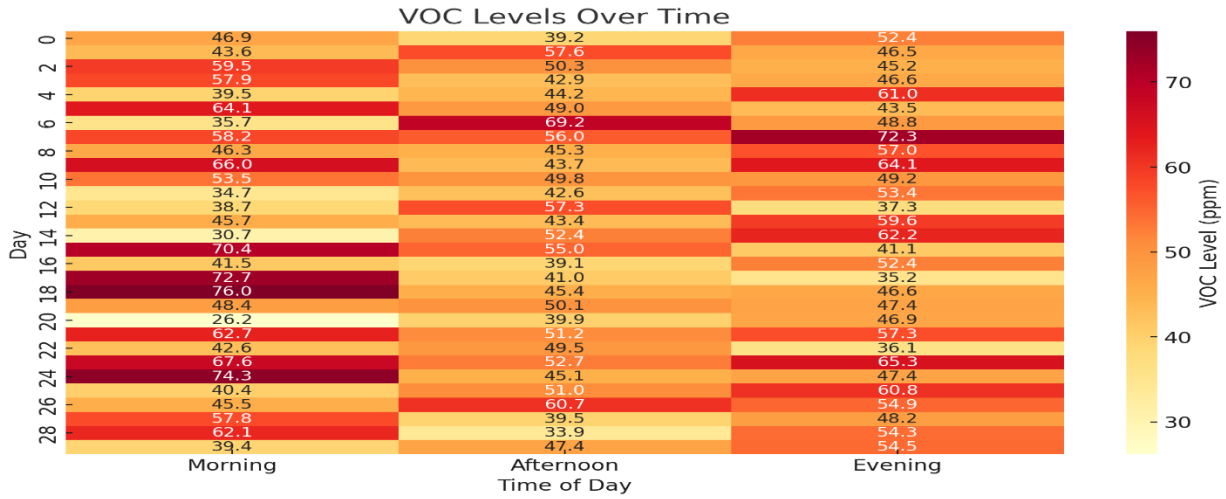
AI Analysis output:

Waste Generation Over Time (Actual vs Predicted): This time-series plot shows the actual and predicted waste generation over 30 days, which could be used to monitor trends and discrepancies in waste volume and adjust reduction strategies accordingly.





Feature Importance for VOC Levels: This bar chart displays the importance scores for various factors impacting VOC levels (e.g., cleaning chemical usage and staff training), derived from a machine learning model, highlighting the most influential features.



VOC Levels Over Time: The heatmap illustrates the VOC levels at different times of day over a 30-day period, identifying patterns in air quality fluctuations and helping in scheduling cleaning to minimize VOC spikes.

Implementation:

The first step was gathering data. Arjun and Lily conducted surveys and used AI tools to track the canteen's waste over several weeks. They discovered that around 70% of the waste consisted of single-use plastic containers and cutlery. Armed with this data, they approached the canteen management, presenting their findings and proposals for change. With management's support, they introduced reusable containers and compostable materials for takeout orders. Arjun sourced eco-friendly cleaning products made from natural ingredients, ensuring that these alternatives were both effective and safe for the environment.

Education and Engagement:

To ensure successful implementation, Arjun organized workshops for both the canteen staff and students. They educated the staff on the benefits of using sustainable products, while students learned the importance of responsible consumption and how their choices could impact the environment. Arjun's charisma and passion for the cause inspired many, creating a ripple effect throughout the campus.

Challenges and triumphs:

Despite the initial enthusiasm, Arjun faced challenges. Some students were resistant to changing their habits, preferring the convenience of disposable items. To address this, the team launched a "swap event," where students could exchange disposable items for reusable ones. They also kicked off a social media campaign, sharing tips and success stories to engage a wider audience. Slowly but surely, positive changes began to take root. The canteen saw a significant decrease in plastic waste, and students reported improved health as the use of strong chemical cleaners diminished. Feedback from the campus community was overwhelmingly positive, and word spread about the canteen's transformation.

Alternative products and solutions:

Eco-Friendly Cleaners: Vinegar and water solutions with lemon or tea tree essential oils were used as natural disinfectants. Enzyme-based cleaners, biodegradable and effective in breaking down organic residues, replaced harsh chemical degreasers.

Compostable Cleaning Tools: Traditional plastic sponges were replaced with coconut fiber scrubbers and biodegradable sponges, which reduced plastic waste and were compostable after use.

AI-Powered Tracking System: Arjun used AI to track product consumption, evaluate cleaner effectiveness, and generate feedback reports. This allowed for a scalable, data-driven approach to managing sustainable solutions.

Impact:
Arjun's initiative not only improved the canteen's ecological footprint but also fostered a culture of sustainability across the university. Other departments took notice, with some even proposing similar projects in their own facilities. The initiative became a case study for future students, showcasing the power of student-led change. In the end, Arjun realized that the journey was about more than just cleaning practices; it was about creating a movement. He had learned the value of collaboration, education, and perseverance. Green valley university became a beacon of hope and an example for other institutions striving towards sustainability.

Epilogue:
Arjun's journey spotlighted the critical need for environmental awareness in college canteens, demonstrating how informed, passionate individuals can ignite change within their communities. The impact extended beyond just cleaner surfaces and less waste; it fostered a generation of students committed to responsible consumption and a healthier planet.

Acknowledgments

This project was made possible by the support of college management, the student sustainability club, and the contributions of canteen staff who embraced change for a cleaner, greener campus environment.

Appendix:

Appendix A: Baseline Data (Before Implementation)

Metric	Monthly Average	Units
Chemical Cleaner Usage	20 Liters	Liters
Cleaning Tool (Plastic) Waste	30 sponges	Units
Cleaning Cost	Rs30000	Indian currency
Staff Satisfaction	65%	Satisfaction (%)
Chemical Residue in Air (VOC)	120 ppm	Parts per million

Appendix B: Pilot Data (During Implementation)

Metric	Week 1	Week 2	Week 3	Week 4	Average
Vinegar Solution Usage	5 liters	5 liters	4 liters	5 liters	4.75 liters
Enzyme-Based Cleaner Usage	2 liters	2 liters	3 liters	2 liters	2.25 liters
Compostable Sponges Used	10	8	10	9	9.25
Cleaning Cost	5000	4000	3000	2500	12625 Rs
Staff Satisfaction	80%	82%	85%	84%	82.75%

Metric	Week 1	Week 2	Week 3	Week 4	Average
Chemical Residue in Air (VOC)	60 ppm	58 ppm	55 ppm	57 ppm	57.5 ppm

Appendix C: Post-Implementation Cost Analysis

Metric	Baseline Cost (Monthly)	Post-Implementation Cost (Monthly)	Cost Reduction (%)
Chemical Cleaners	Rs 30,000	Rs 12,500	58.33%
Compostable Cleaning Tools	(Plastic) Rs 10,000	Rs 7,500	25%
Waste Disposal	Rs 5,000	Rs 3,500	30%
Total Monthly Cleaning Cost	Rs 45,000	Rs 23,500	47.78%
Staff Satisfaction Improvement	65%	82.75%	-
Chemical Residue in Air (VOC)	120 ppm	57.5 ppm	-

Appendix: D AI driven analysis focus

Analysis Focus	Insight	Suggested Action
Peak Waste Times	Highest waste during lunch (12 PM - 2 PM)	Increase staffing for sorting during peak hours
High-Waste Items	Plastic cutlery, single-use boxes	Replace with compostable/reusable alternatives
Air Quality Concern	VOC levels spiking during heavy cleaning times	Switch to non-toxic, natural cleaning agents
Cost Impact	High spending on disposable items	Promote reusable containers to reduce costs