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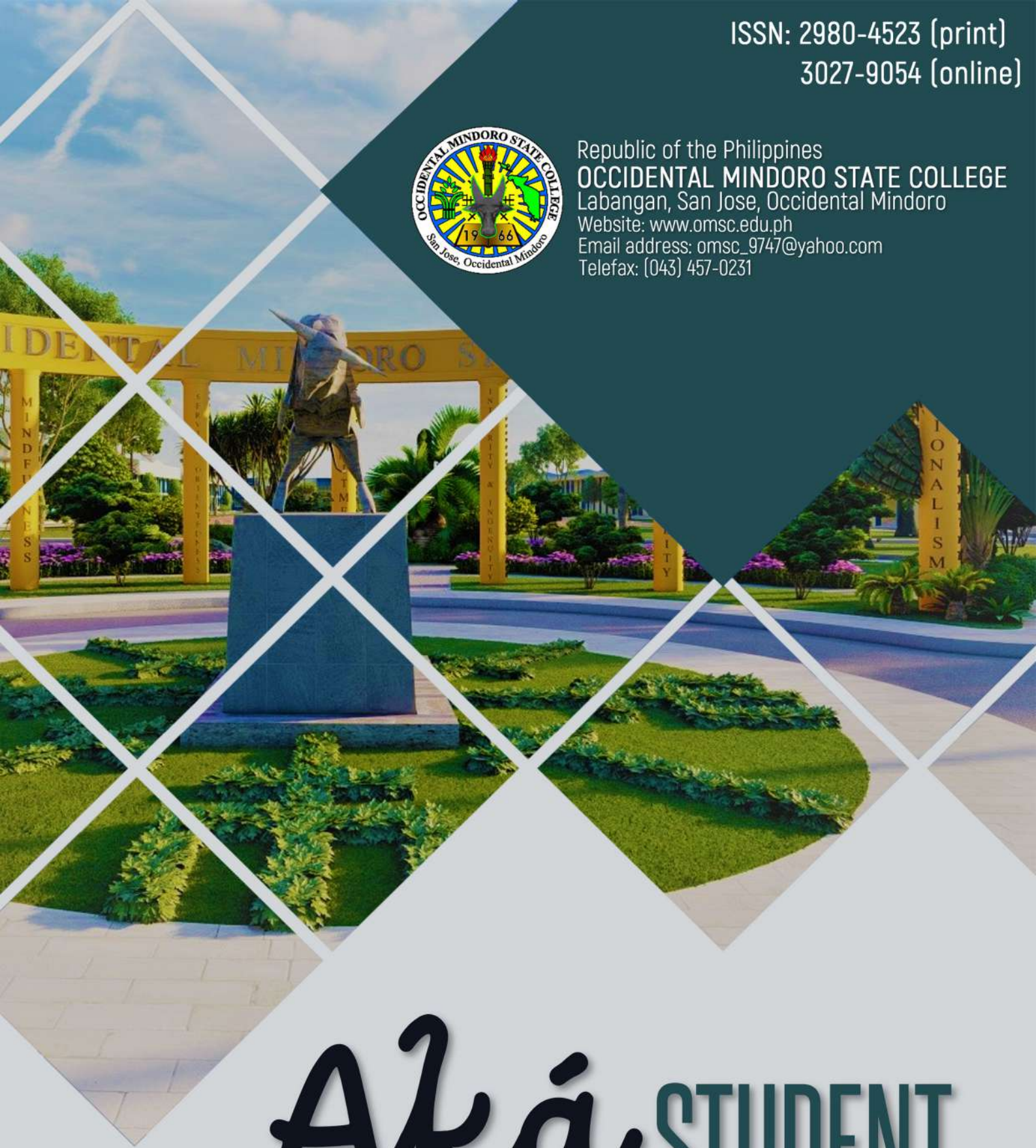

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ABOUT THE JOURNAL

"Aká" is a Hanunuo Mangyan term for "first born." The Occidental Mindoro State College (OMSC) believes this publication is first of its kind in the MIMAROPA Region. It is an academic, multidisciplinary and faculty and expert-reviewed journal devoted to the rapid dissemination of current research. It is published annually to document the research endeavors of the students presented in the Annual Student Research Congress.

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SHOWCASING STUDENT CONTRIBUTIONS TO KNOWLEDGE DRIVEN BY INTEGRITY AND PURPOSE

Artemio M. Gonzales Jr., MPH, MAN
Editor-in-Chief

In this era when academic success is often measured by metrics and rankings, it is important to look beyond the numbers. We should recognize integrity and purpose as the core values for students' academic achievement and success. These values will support advancing knowledge that in ways that benefit our community, improve our professional practice, and uphold the values of higher education.

Integrity in research is a multifactorial and dynamic construct that relates to individual moral character and a strong sense of responsibility. It emphasizes ethical, honest, robust, and transparent conduct in proposing, conducting, evaluating, and reporting research findings. It also includes ethical practices such as collaboration, accurate attribution, and ethical handling of research subjects. At the institutional level, integrity is shown by creating an environment that supports adherence to legal and ethical standards, which in turn promotes good research practice (National Academies Press (US), 2002). Recently, integrity concerns including fraudulent research, reproducibility challenges, and questionable practices (including gift authorship), has raised critical questions about the reliability of scientific output have brought attention to the risks of compromised integrity. These issues can create a domino effect that would ultimately influence professional practice and policy landscape. Ensuring research integrity requires not just rigorous methods and clear reporting, but also a change in research culture that is supported by strong institutional frameworks. This includes clear policies and guidelines, effective training, and mentorship. Factors like incentive systems and recognition also play a major role in influencing researcher's behavior (Armond et al., 2024). Maintaining the trustworthiness of science requires collective effort from academic community. We must strengthen ethical standards and encourage a culture of integrity in the scientific and academic community. *As Occidental Mindoro State College gears toward university status, is it ready to establish a Research Integrity Committee or Office to uphold research standards and ethical practices?*

Social value refers the direct benefit that the research findings will provide to individual, groups, and society but not limited to financial and economic gains. It includes different aspects, such as improving human well-being, meeting societal needs, and promoting ethical behavior. Conceptually, social value can stem from moral obligations, individual perceptions of benefit, or targeted responses to the needs of disadvantaged groups. It is created through firm actions, individual decision-making, or institutional practices, and can be captured by beneficiaries, specific stakeholders, or individuals. Ultimately, social value represents the

betterment of living conditions and the promotion of the common good within interconnected human, institutional, and environmental systems (De La Cruz Jara & Spanjol, 2024).

This issue proudly showcases a range of student outputs that span disciplines and address real-world challenges within the island of Mindoro. These include an insightful analysis of organizational culture's influence on management accounting practices in agricultural cooperatives and a timely examination of digital transformation in grocery retail. In the health sciences, student researchers applied protection motivation theory to schistosomiasis prevention among adolescents in Oriental Mindoro, while others explored the psychological effects of short-form video exposure on emotional stability in young adults. Agricultural innovation likewise showcased through studies on sweet potato yield using coconut-based biochar, the efficacy of ginger and seaweed-based edible coatings for onion preservation, and tomato rootstock compatibility. In education, an interactive online simulation was evaluated for its effectiveness in teaching motion concepts to elementary students, while another group examined the effect of sports imagery on football athletes' confidence. Information technology and engineering students featured the development of a solar-powered phytoremediation system for improving river water quality, ergonomic risk assessment in rice milling, and a disaster incident victim identification system for local government use. Each of these works not only demonstrates research competence, but more importantly, reflects a commitment to integrity, relevance, and socially responsive innovation.

Let this editorial serve as recognition of what has been done right and a call to continue nurturing habits of integrity in an age of increasing complexity. As we move forward, may we remember that real achievement is not only measured in grades, publications, or awards, but in the values upheld along the way. As educators, it is our responsibility to help students find and define this purpose to ask not only *"What are you studying?"* but also *"Why does it matter to you and others?"*

REFERENCES

Armond, A. C. V., Cobey, K. D., & Moher, D. (2024). Research integrity definitions and challenges. *Journal of Clinical Epidemiology*, *171*, 111367. https://doi.org/10.1016/j.jclinepi.2024.111367

De La Cruz Jara, M. F., & Spanjol, J. (2024). Understanding multiple perspectives on social value in business: an integrative review and typology. *Journal of Business Ethics*. https://doi.org/10.1007/s10551-024-05692-1

National Academies Press (US). (2002). *Integrity in research*. Integrity in Scientific Research - NCBI Bookshelf. https://www.ncbi.nlm.nih.gov/books/NBK208714/

NAVIGATING THE INFLUENCE OF ORGANIZATIONAL CULTURE ON THE IMPLEMENTATION OF MANAGEMENT ACCOUNTING PRACTICES IN AGRICULTURAL COOPERATIVE: INSIGHTS FROM SAN JOSE, OCCIDENTAL MINDORO

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ABSTRACT

This study examines how organizational culture affects the implementation of management accounting practices as applied in agricultural cooperatives in San Jose, Occidental Mindoro. While agricultural cooperatives have been instrumental in rural development, cooperatives still cited significant challenges when it comes to managing the organization: the key challenges are limited member participation, resistance to change, poor communication and weak financial systems. The study guided by Edgar Schein's Organizational Culture Model and a qualitative case study design, with purposive sampling of 15 purposefully selected members, leaders and stakeholders of the agricultural cooperatives researched. Data were analyzed thematically. The study had the following aims: (1) identify cultural barriers and facilitators in cooperatives, (2) assess barriers and facilitators in the decision to adopt management accounting practices, and (3) provide the cooperatives with a strategic roadmap to improve their financial performance and operational productivity. The results reveal eight central cultural themes cited as barriers: constrained development, limited training opportunities, weak participation; and enablers: democratic governance, sustainable development, inclusiveness and community policies. The study identified three overarching factors – capacity building, financial sustainability, and operational productivity – that are vital to adopting accounting practices. The findings suggest that fostering trust among members and building confidence through transparent structure systematically improves member accountability, and resilience over the long run if cooperatives re-align their values with a documented financial system. It is proposed that cooperatives should invest in leadership and financial literacy training, implement digital accounting systems, and establish stronger internal controls to boost participation, achieve reliable financial reporting, and achieve durability and sustainability.

Keywords: *agricultural cooperative, management accounting practices, organizational efficiency, sustainable development*

SDG: *SDG 8: Decent Work and Economic Growth*

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INTRODUCTION

In the Philippines, agricultural cooperative plays a pivotal role in enhancing the productivity and resilience of rural communities. By enabling farmers to combine resources, use market together, and take advantage of shared services, cooperatives help to reduce poverty and support local economic growth (Birchall, 2022). However, despite their potential, agricultural cooperatives still have ongoing problems that compromise their capacity to effectively serve their members, sustainability, and efficiency. These difficulties including insufficient education and training, poor governance systems, lack of capital access, and substandard internal communication. In the Philippines, agricultural cooperative success is influenced by a range of socio-economic and institutional factors, including organizational culture, leadership, and member participation (Bati, 2020). Financial instability and inefficiencies stem from a lack of professionalism in management and low member participations, along with little implementation of simple, effective operations and accounting practices (Shofiyuddin & Taruma, 2020).

Organizational culture can be defined as a shared set of values, beliefs, norms, and assumptions that guide human behavior within the organization and leads to an environment where people feel valued and motivated to perform at their best. It is an important driver of operational strategies, decision-making, and performance within agricultural cooperatives. In areas such as San Jose, Occidental Mindoro–where agriculture remains the primary livelihood and agricultural cooperatives contribute significantly to rural development and poverty reduction–organizational culture becomes even more critical. Effective implementation of management accounting practices, which promote transparency, efficiency, and sustainability, is essential to cooperative success (Susilawati, 2022).

To effectively enhance the significance of agricultural cooperatives in rural development, it is critical to grasp the complexities of the challenges that cooperatives experience at both an organizational structural level and from the broader scene of socio-economic contexts. Understanding these aspects is what this study seeks to offer to support the sustainable development of agricultural cooperatives in San Jose, Occidental Mindoro by highlighting relationships between management accounting, organizational behavior, and the development of cooperatives.

The study utilized Schein's (1985) Organizational Culture Model to carefully analyze the influenced of cultural aspects of agricultural cooperatives on accounting management practices implementations. By investigating the cultural layers artifacts, espoused values and basic underlying assumptions, this paper seeks to reveal how cultural artifacts, and the basic underlying assumptions contribute to, or diminish, financial accountability and transparency and operational effectiveness.

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MATERIALS AND METHODS

Research Design

Qualitative case study designs were employed to study how the organizational culture influences management accounting practice implementation in agricultural cooperatives in San Jose, Occidental Mindoro. The strength of this design is embedded in examining contemporary real-life situations from where the situation and its context are not clearly evident. The advantage of using case study design is that it helps the researchers hold tight onto a specific group in a confined locale, thus facilitating in-depth understanding of the cooperatives' members, their lived experiences, and those of their leaders and stakeholders.

Study Settings

This study was conducted in San Jose, Occidental Mindoro, a first-class municipality in the Philippines known for its strong agricultural economy and an active network of cooperatives. The site was picked for being an area with numerous agricultural cooperatives and, thus, a relevant and meaningful locale to examine the linkages between organizational culture and management accounting practices. As the province's agriculture trade center, cooperatives play a huge role in the development of the local economy. Thus, the cultural scene of the region is a collaboration of traditional and innovative management practices, and hence it is the appropriate environment for inquiry into internal cooperative culture-linkages and the adoption and implementation of accounting systems. The environment provided real-world attention to the interaction between leadership, members, and management processes within the cooperative.

Participants

The study units for analysis were people who actively participated in agricultural cooperatives: cooperative members, leaders, and relevant stakeholders. From an initial list of 30 identified cooperatives, purposive sampling led to the selection of 15 participants based on direct involvement in their cooperatives' decision-making, financial reporting, and cultural leadership. Selection was based on the idea until data saturation was achieved, thus ensuring that no additional interviews brought in new or meaningful information.

Purposive sampling was utilized to choose key participants with rich and relevant experience with respect to the study objectives.

Inclusion criteria:

1. Members of agricultural cooperatives in San Jose, Occidental Mindoro.
2. With relevant experience of at least one year in the cooperative.
3. Knowledgeable about management accounting practices.

Exclusion criteria:

1. Not a member of any agricultural cooperative in San Jose, Occidental Mindoro.
2. No relevant experience in management accounting practices.
3. Unwilling or unable to provide insights.
4. With any pertinent conflict of interest that may render said data in question.

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Data Collection Procedure

Interviews were conducted within the period of 2 weeks where the arrangements were made to conduct either face to face or through distributed questionnaires in case of schedule overlap. Each interview lasted for an average of 45 to 60 minutes. There was much encouragement to have free expression of thoughts from the participant as open-ended questions enable elaboration. Moreover, those interviews were recorded with the participants' consent, and field notes were taken to write comments on non-verbal cues, and to document reflections and contextual observations. This flexible but structured manner guarantees exhaustively rich qualitative material.

Ethical Considerations

To ensure confidentiality, all identifying particulars were revised in the course of transcription and analysis. The raw data were made available only to researchers who were responsible for keeping data secure during the entire process of its usage for research. As regards internal cooperative-sensitive operation and the role of the participant, respect was accorded to culture and portrayal of the organization during data collection and reporting. Ethical clearance and guidance were acquired from the appropriate academic body governing the research.

Data Processing and Analysis

Data were analyzed thematically according to Braun and Clarke's (2006) six-phase framework. Researchers first understood the transcribed interviews by thoroughly reading and reviewing the responses, allowing key ideas and initial impressions to emerge. The next step was the generation of initial codes to capture ideas that recur concerning organizational culture and management accounting practices.

These codes were then examined and arranged into broader themes in line with the objectives of the study. Upon the identification of preliminary themes, the researchers reviewed them for fittingness and comprehensiveness to ensure consistent intra-subject correspondence and appropriate representation of the dataset. Each theme was then duly defined and named, and woven into a vivid narrative that accounted for the experiences and perceptions of the participants. To testify to the credibility of the analysis, key points were illustrated with direct quotations from participants. This thematic endeavor prompted a rich and detailed understanding of the organizational culture in the implementation of management accounting practices adopted by agricultural cooperatives in San Jose, Occidental Mindoro.

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RESULTS

Key Barriers of Existing Organizational Culture

Four key themes have emerged for the key barriers on existing organizational culture including (1) Member Behavior and Participation, (2) constrained development, (3) cooperative communication and participation challenges, and (4) lack of training and education.

Theme 1. Member behavior and participation

Some members of the cooperative are unwilling to fulfill their duties particularly in loan repayments and personal commitment to cooperative activities. This is due to members prioritized personal schedule rather than attending important meetings because they believe that it is just a waste of time. Based on the observation of the leader:

> *"Uhm...of course there's a lot of instances especially where we are Agricultural cooperative, and it is unavoidable. But there's no specific problem in terms of organizational culture. Only that our members are hardheaded from their obligations, and some are delayed payment of loans (past due). Another problem is their personal commitment, like instead of attending their assembly or emergency meeting they usually consider the time and distance that will be consumed where they taught it's just a waste of time. As for addressing these barriers we conduct regular follow up for our members to ensure that they are all well informed in our cooperative activities."*

Theme 2. Constrained development

Cooperatives are afraid to adopt new opportunities and still preferred the traditional methods leading to resistance to innovation and hindering their development. Despite its goals of democratic engagement and accountability, member of the cooperative express their concerns about risk, learning curves, and power dynamics. As a results, members of the cooperative observed:

> *"Most of the time when it hinders the development of cooperation, we only have a problem in resistance to innovation and fear of adopting unfamiliar things, but I think it's not really considered as values or even norms."*

Theme 3. Cooperative communication and participation challenges

Some members of the cooperative mentioned that some people only enjoy benefits, like services at a discounted rate but do not engage in any cooperative activities. Because these activities are voluntary and unpaid, many members opt out of them, so their involvement is low. This leads to this mindset of being less transparent and involved regarding finances, decision-making, and planning. The following claims were undoubtedly made by all cooperative members:

> *"Umm...members...In members po? Yes, some members are not so active in the cooperative. [why? Are they're voluntary like the others po they also have the*

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same problem as yours due to some members and officials are voluntary] ahh no, we have a our own assets, but they get a benefits here like when they need to use the tractor they can get a discount, means they pay less than the usual because the cooperative not earning incentive"

Theme 4. Lack of training and education

Leaders of the cooperative need to be knowledgeable and properly trained to guide the organization effectively. Magbamboo Cooperative having difficulty with vermiculture and managing its resources due to lack of proper training for the members of the cooperative. This made it hard for them to stay productive. Evidently, the cooperative members offered the following feedback:

"In our cooperative's experience with vermiculture, we encountered challenges due to some members lacking sufficient knowledge and training in this area. This led to operational setbacks and financial losses. For instance, without a clear understanding of optimal worm care and composting techniques, we faced issues with maintaining worm populations and ensuring high- quality vermicompost production."

Facilitators of Existing Organizational Culture

Four themes are identified concerning the facilitators on existing organizational culture. These are (1) democratic governance and decision-making, (2) sustainable development and social impact, (3) membership benefits and discounts, and (4) resource allocation and inclusive community policies.

Theme 1. Democratic governance and decision-making

Members perceive democratic governance as essential for transparency, equity, and cultural values, although it occasionally faces pushback against innovation and unfamiliar practices. As a result, cooperative members agreed upon:

"Most of the time when it hinders the development of cooperation, we only have a problem in resistance to innovation and fear of adopting unfamiliar things, but I think it's not really considered as values or even norms. However, our values or norms that characterized our cooperative were embody by cooperative values that promotes democratic participation and being transparent and accountable. While with the leadership system we are democratic all have the right to raise their voice and speak for themselves and all decision making is always based on its majority."

Theme 2. Sustainable development

Cooperatives promote sustainable development and social impact by harmonizing current demands with future objectives through responsible business practices, community engagement, environmental stewardship, financial resilience, and robust member connections. The data revealed this theme, as two participants noted:

"Yeah... our goal is the development of our cooperative and support our members through sustainable practices, ethical ideals, and community participation to ensure long-term profitability and a positive social impact."

"Our goal is to continue growth and success for our cooperative and with our cooperative members. And to enhance our productivity and increase profitability"

Theme 3. Membership Benefits and Discounts

Cooperatives foster member loyalty by offering discounts and additional dividends through the "balik tangkilik" initiative. These benefits are awarded to engaged members who participate in activities and promptly repay their loans. Several members shared similar sentiments, such as

"They only got a discount when using the tractor. If you're not a member we charge them 3,300 but in members they only pay a 3,000."

"And in turn for our members we implemented a balik-tangkilik where, within one year we add a dividend of the members based on how much is the profit of the cooperative."

"We also implement the 'balik-tangkilik' where in we add to the dividends of the members once the cooperative gains a profit from our businesses."

Theme 4. Resource allocation and inclusive community policies

Cooperative distributes resources through the BARWASA system, restricted to Bayotbot residents based on a barangay agreement. Members contribute a fee and CBU payments to benefit from reduced rates, fostering equity and community participation. Supporting this claim, a member expressed:

"The only way to use BARWASA water is up to Bayotbot, as stipulated in the barangay's MOA. This agreement was established before the irrigation project, which was funded by Plan International. Before the project commenced, the MOA was finalized, outlining the terms between the Mangyan community and the barangay council. Moreover, using BARWASA water requires individuals to become members, which entails paying a membership fee and an annual CBU (capital build up) fee. Members pay 10 pesos per cubic meter, while non-members pay 30 pesos per cubic meter."

Management Accounting Practices

Three key themes have emerged regarding the influence on adoption of utilization of management accounting practices, these are (1) capacity building, (2) financial stability, and (3) organizational efficiency.

Theme 1. Capacity building

Member of the cooperative declare that training and seminars from Department of Agriculture (DA) helps them to better understand different accounting process and meet

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requirements more easily. They shared that these programs sharpen their skill level in terms of financial management, decision making, and governance that contribute to the achievement of cooperative goals. This perspective is echoed in the words of a participant:

> *"Yes, training programs exist, but we are not the ones responsible for conducting them. It was set and conducted by DAR and DA for us to familiarize ourselves and be knowledgeable in management accounting so that this will help us to comply with the given requirements and we also have seminars where we are all able to know the fundamental governance. Last year, we had a two- or three-times training program for the board of members and stakeholders, and this will help us to get projects from the agricultural cooperative."*

Theme 2. Financial stability

Financial transparency among agricultural cooperatives becomes an essential trust-building, conflict-avoiding, and fostering accountability in the adoption of management accounting practices. Members declared that they are well-informed and involved through regular record-keeping and quarterly meetings where financial matters are openly discussed. Transparency would also lay the foundation for the next level of management accounting practice to be employed in the cooperative's financial management and decision-making toward long-term sustainability. This finding is reflected in the statement:

> *"Oh... we only used bookkeeping for financial reporting and were transparent. We allowed our members to know about their financial concerns to avoid conflicts and doubt. And we have quarterly meetings."*

> *"I think our auditor and treasurer is more knowledgeable about this. But then maybe I can share something. Well, we are transparent in terms of our financial statement in which all members have the right to know about this information. And we have this monthly reporting about our expenses and budget and aside from computation from our auditor we also conduct double checking if the given information is all well accurate and after that this will be communicated and reported from our stakeholders so that we can ensure that all information is valid and approved before reporting to our cooperative members."*

Theme 3. Organizational efficiency

Due to well-organized reporting and auditing systems, agricultural cooperatives achieve high organizational efficiency in carrying out their activities. Accordingly, duties are clearly assigned so that operations can run smoothly. The structure thus works with all acknowledgments from management heading and the internal audit team and then verified by external experts for transparency and accuracy in financial management. Members proclaimed that being efficient also means legal requirements being adhered to, while advancing the use of modern management accounting systems for better financial control in support of sustainable development. This was confirmed by a respondent who mentioned:

"Each person here has different responsibilities. We undergo monthly reporting, which passes through us to ensure accuracy. We have a system in place where our manual audits transition into our system. Afterward, we create reports from the administrative head and internal audit. Once verified by our consultant, we maintain consistency in verification."

Constrained Cooperative Roadmap

This is the action plan for instituting Management Accounting Practices (MAPs) in the agricultural cooperatives of San Jose, Occidental Mindoro: making environments conducive to the penetration of transparency, strengthening technical capacity, and ensuring sustainable development. The program has key strategic objectives in developing its organizational culture, the technical aspect, and an efficient monitoring and evaluation system.

This action plan provides a strategy for addressing cultural and managerial challenges faced by agricultural cooperatives in San Jose, Occidental Mindoro. The proposals are based on the findings in this study, and it intends action which is practical, inclusive, culturally appropriate, and will improve the cooperatives' prospects for the future.

Table 1. Constrained cooperative roadmap for agricultural cooperative in Occidental Mindoro, Philippines.

Key Areas	Strategies	Timeframe	Responsible Parties	Resources Needed	Success Indicator
Organizational cohesion and effectiveness	Needs assessment, engagement plans, workshops, incentive programs	1 year	Cooperative management, LGU, community organizations	Workshop materials, communication tools, incentives	Increased member participation and feedback
Skills and knowledge	Training needs analysis, program design, training sessions	1 yr & 3 mos	CDA, TESDA, training providers	Training manuals, facilities, trainers	Improved member skills and training participation
Cooperative operation expansion	Identify constraints, develop strategies, partnerships	1 yr & 6 mos	Financial institutions, government agencies	Infrastructure investment, technical assistance	Improved efficiency and financial stability
Environmental, social, and economic outcomes	Sustainability programs, awareness campaigns, policy advocacy	2 years	Environmental agencies, DA, NGOs	Sustainability tools, workshop materials	Adoption of sustainable practices
Financial management system	Evaluate practices, financial training, software implementation	8 months	Local financial institutions, cooperative management	Software, financial experts, training materials	Improved financial reporting and audits
Budget planning and control	Identify revenue streams, market research, pilot projects	6 months	CDA, local financial institutions	Market data, planning tools	Accurate budgets and new revenue sources
Operational processes	Process mapping, training, workflow improvements	6 months	LGUs, CDA, cooperative management	Process tools, staff training support	Shorter processing times and increased efficiency
Performance measurement system	Define KPIs, integrate tools, dashboard setup	5 months	Cooperative management, local financial institutions	Monitoring software, KPI framework	Improved tracking and decision-making

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DISCUSSION

This study focuses on organizational culture and its relevance in management accounting practices implementation within agricultural cooperatives situated across San Jose, Occidental Mindoro. Similarly with other cooperatives in different rural contexts, several cultural and operational diversities significantly influenced management tool knowledge, acceptance, and adaptation.

Among the barriers probably the behavior and involvement of the members is considered as challenging for cooperatives. Lack of participation in the cooperative activities, whether in attendance of meetings or in the achievement of monetary obligations, resulted in disruption of operations and weaker organizational culture. Awoke et al. (2021) observed that absence of commitment by members affects success in the cooperatives. Member non-participation would affect not just the flow of communication but the decision-making processes that are crucial to finance planning. Resistance to change is one of the significant limitations most of them preferred being traditional. Despite of new financial systems and computerized tools available, still most of them are hesitant in implementing this modernization. Thus, such resistances capped the possibility of modernization for the advantage of transparency and efficiency.

Disrupted communication combined with irregular member participation poses another significant challenge. This communication gap between the foremost officers and the members put a barrier on governance and transparency. Limited training prevented the application of many of the tools which otherwise could have aided in planning, monitoring, and deciding. Regular training and education are indeed important for enabling cooperative members to contribute meaningfully to financial discussions (Lawrence, 2023).

Cultures, nevertheless, have created strengths that aided the cooperative in its operations. The democratic governance structures enabled the members to be heard in decision-making, thereby instilling fairness and accountability in the system. Evidence indicates that such inclusive systems enhance participation and encourage shared responsibility (Boevsky, 2022).

The social prospect and sustainability were also key successes in the manner of cooperative operation. Some are not profit-based; they also considered the needs of society in a wider area and the environment when strategizing. The dual focus maintained long-term commitment and observance of cooperative principles. Mojo et al. (2021) explored similar themes as well, stressing how socially embedded cooperatives better perform compared to their counterparts regarding member retention as well as ethics. Membership rewards and benefits also served a motivational function. Such benefits helped keep members motivated and active which helped to contribute to have a sense of value and ownership. Cruz et al. (2023) pointed out that material member benefits tend to lead to increased loyalty and greater involvement in cooperative governance and strategy.

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These cooperatives have shown higher success rates in adopting management accounting practices when capacity building and training were carried out for the cooperative members. Members who were trained, sometimes using government-backed institutions, have reported greater confidence and understanding in financial systems. The training, according to the findings of Gérard et al. (2019), serves the purpose of bettering performance while increasing accountability among the members.

An organized accounting systems will ensure operational efficiency significantly. They allow cooperatives to prepare, track expenditures, and measure financial health more precisely. Reyroso et al. (2023) stated that such efficiency results in optimal usage of resources and strategic decision-making based on those resources. This transparency encourages all members to engage in discussions on the financial affairs, thus engendering a culture of openness. According to Dimas et al. (2022), transparency is linked with efficient and responsive governance.

In conclusion, in San Jose, agricultural cooperatives faced hindrances like disengaged members, resistance to change, and lack of training, whereas culture that strengthened democratic governance, sustainability, and member-centered policies greatly helped to enhance the acceptance of management accounting practices. The findings indicate that internal cultural factors need to be understood and addressed alongside broader financial and operational reforms.

CONCLUSION

Agricultural cooperatives in San Jose, Occidental Mindoro, face challenges in adopting management accounting practices. Through these, the most persistent problems deal with cultural barriers such as deeply rooted habits and resistance to change, lack of communication, and limited training resources. This resistance is worsened by insufficient training resources and outdated communication channels, which collectively contribute to low engagement and reduced efficiency among cooperative members. These challenges are heightened by a limitation of several cultural strengths that support cooperative resilience, such as collaboration, democratic governance, and shared decision-making. Despite such challenges, such agricultural cooperatives have the skills to adapt a foundation for building cooperative resilience and trust, essential for adapting to new management practices without compromising the cooperative's core values. These cooperatives members combined strategies to enable them to sustain their leadership and enhance members' skills in financial management. With clear guidelines, performance metrics, and periodic evaluations, operations and sustainable development improve financial transparency and encourage member participation. This will create a resilient structure for cooperatives in the region.

To attain sustainability and growth in Agricultural cooperatives by cooperative members, the following are some recommended actions: Implement leadership and communication training to foster trust, transparency, and inclusivity. This training should focus

on effective ways for leaders to communicate with members and encourage a culture where everyone feels their voice is valued. In addition, offer financial education that covers both basic and advanced accounting principles to equip members with the knowledge needed for effective financial management. Providing financial education with fundamental and advanced management accounting, empowers members with tools to make informed decisions, manage money and resources, and help ensure organizational sustainability. Finally, create a constrained cooperative roadmap that outlines clear, manageable steps toward sustainable growth. Members of cooperatives can use the constrained cooperative roadmap, a useful tool to create a realistic, step-by-step plan for sustainable development. The constrained cooperative roadmap is intended to help cooperative members set realistic goals, identify their key priorities, and tackle community/organization development while using their limited resources effectively. The constrained cooperative roadmap is designed to help cooperative members stay on track, work together more effectively, and confront challenges in a way that supports their long-term sustainability

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REFERENCES

Awoke, H. M. (2021). Member commitment in agricultural cooperatives: Evidence from Ethiopia. *Cogent Business & Management*, 8(1). https://doi.org/10.1080/23311975.2021.1968730

Bati, M. (2020). Determinants of success and coping strategies of collective action in Ethiopia: The case of agricultural cooperatives. *Journal of Economics and Sustainable Development*, 11(9), 1–5. https://doi.org/10.7176/jesd/11-9-01

Birchall, J. (2022). The role and potential of co-operatives in the poverty reduction process: A research agenda. Journal of Co-operative Studies, 55(1), 118–128. https://doi.org/10.61869/plps7193

Boevsky, I. (2022). Cooperative culture and cooperative governance structure of agricultural cooperatives. *Scientific Works, LXIV,* (1), 9–20. https://doi.org/10.22620/sciworks.2022.01.001

Cruz, L. S., Cuevas, A. C., Asma, J. D. S., Duque, J. R. D., & Orlina, B. M. (2023). Does membership in agricultural cooperatives improve marketing efficiency?: Insights from smallholder coffee

farmers in selected provinces of the Philippines. *International Academy of Global Business and Trade*, 19(1), 1–13. https://doi.org/10.20294/jgbt.2023.19.1.1

Dimas, B., Lyne, M., & Bailey, A. (2022). Identifying and addressing institutional problems constraining the financial performance of rice cooperatives in the Philippines. *Asian Journal of Agriculture and Rural Development*, 12(3), 148–156. https://doi.org/10.55493/5005.v12i3.4527

Gérard, A. E., Francis, N. O., Esther, O. O., & Abdulahi, T. O. (2019). Capacity building in cooperative Organization: ground for change. *Archives of Current Research International*, 1–12. https://doi.org/10.9734/acri/2019/v17i430119

Lawrence, O. M., Komba, S. C., & Iwata, J. J. (2023). Effect of cooperative education and training on the performance of agricultural marketing cooperative societies in Ukerewe and Sengerema, Tanzania. *East African Journal of Education and Social Sciences*, 4(1). https://doi.org/10.46606/eajess2023v04i01.0254

Mojo, D., Fischer, C., & Degefa, T. (2015). Social and environmental impacts of agricultural cooperatives: evidence from Ethiopia. *International Journal of Sustainable Development & World Ecology*, 1–13. https://doi.org/10.1080/13504509.2015.1052860

Reyroso, J. a. M., Ibarra, V. C., & Reyroso, C. J. (2023). Costing, planning and control, and strategic management accounting practices of SMEs: Evidence in the Philippines. *Corporate Sustainable Management Journal (CSMJ)*, 1(1), 06–10. https://doi.org/10.26480/csmj.01.2023.06.10

Schein, E. H., & Schein, P. (2018). *Organisationskultur und Leadership*. https://doi.org/10.15358/9783800656608

Shofiyuddin, M., & Taruna, M. S. (2020). Analisis kinerja keuangan dan strategi keberlanjutan pada koperasi Kud "X" Pekalongan. *Jurnal Ekonomi Dan Bisnis*, 23(2), 36. https://doi.org/10.31941/jebi.v23i2.1217

Susilawati, M. (2022). Akuntansi manajemen strategik pada koperasi (Strategic management accounting in cooperatives). *ABM. Akuntansi Bisnis & Manajemen*, 29(2), 102. https://doi.org/10.35606/jabm.v29i2.1107

DIGITAL TRANSFORMATION IN GROCERY STORES: ADOPTION AND IMPACT IN SAN JOSE, OCCIDENTAL MINDORO

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ABSTRACT

From the transition of traditional grocery stores to digital platforms, the landscape of the grocery store undergoes a profound advancement. Through digital transformation adoption, these stores redefine customer experiences, offering convenience, personalization, and efficiency, thereby reshaping operations and market dynamics. This research examines the impact of digital transformation on grocery stores operations in San Jose, Occidental Mindoro. The study aims to determine the extent to which the digital transformation including product, manpower knowledge and skills, customer engagement, market analysis affect various aspects of grocery stores operations such as inventory management, marketing, supply chain, human resource management, and capacity management. The findings reveal that digital transformation is reshaping market analysis and redefining how businesses interpret and respond to market dynamics. With its high and positive impact, digital transformation empowers companies to harness the power of data-driven insights, optimize marketing strategies, and capitalize on emerging market opportunities swiftly. Also, digital transformation plays significant role to the adaptability and flexibility of the business operation to the inevitable conditions brought by the changing business environment. The result seemingly presents a moderately positive relationship indicating that when the adaptation of digital transformation increases or high, then there is as well a corresponding increase in grocery store operations performance. Therefore, with the adoption of e-commerce, retail grocery stores can better manage customer experience, improves inventory management, enables personalized marketing, optimizes supply chains, boosts operational efficiency, facilitates data-driven decision-making, and provides a competitive advantage.

Keywords: *adoption, correlation analysis, digital transformation, grocery stores, operations*

SDG: *SDG 8: Decent Work and Economic Growth, SDG 9: Industry, Innovation and Infrastructure*

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INTRODUCTION

The digital age has brought big changes, affecting how people and businesses use technology and information. Grocery stores, in particular, have become places where new ideas and changes happen. Instead of just physical stores, groceries are now becoming digital, which is changing how people shop and how the local economy works.

The integration of cutting-edge digital technologies, such as sophisticated inventory management software, seamless online ordering platforms, and advanced point-of-sale systems, is poised to revolutionize the grocery store experience. Digital transformation presents significant challenges and opportunities in the highly competitive, low-margin world of the grocery industry (Kullak et al., 2022). The rapid development of digital technology has caused a substantial transformation in the grocery retail sector in recent years. Previously distinguished by conventional brick and mortar operations, grocery stores are now leading the way in the digital transformation revolution. This transition is not only occurring in urban areas but also in places like San Jose, Occidental Mindoro, where grocery stores are essential for meeting the requirements of the local populace on a daily basis.

The COVID-19 pandemic led to unprecedented change in customer behaviour (Eger et al., 2021). The general uncertainty and distress witnessed at the initial phase of the pandemic was clearly demonstrated in the grocery sector where customers were seen hoarding dry food, canned food, and other products such as toilet paper (Hultman & Egan-Wyer, 2022). Although online grocery shopping has witnessed stable growth in the last decade (Pantano et al., 2020), it skyrocketed during the COVID-19 pandemic. This was evidenced by a sudden rise in new online orders (Ali, 2020). Online grocery store sales tripled at the early stages of the pandemic as food retailers resorted to the already growing e-commerce business.

Thus, San Jose, Occidental Mindoro, like many regions worldwide, experienced a significant shift in its approach to digital transformation during and after the pandemic. The pandemic acted as a catalyst, accelerating the adoption of digital technologies in various sectors, including the local grocery and retail industry. In San Jose, Occidental Mindoro alone there are sixty-five (65) licensed grocery stores that offer a wide variety of products in lieu with the customer needs and demands. Consequently, the researchers were urged to study the research due to compelling reasons that highlight the significance of investigating digital transformation in grocery stores and its adoption and impact in San Jose, Occidental Mindoro. The grocery retail industry is currently undergoing a profound transformation on a global scale, driven by rapid advancements in digital technologies. These changes have the potential to reshape consumer shopping habits, alter the operational landscape of local retailers, and ultimately impact the region's economic dynamics. Therefore, understanding the specific areas of digital transformation in San Jose is essential to grasp how local businesses adapt to these global trends.

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METHOD

Study Design

This study employed a descriptive-correlational research design. Descriptive-correlational research is a research method that determines the current phenomenon. Descriptive statistics explained and interpreted the present state of individuals, settings and conditions, or events. Descriptive research aimed to provide an accurate description of a phenomenon, in this case, the relationship between the adoption and impact of digital transformation in grocery stores.

Study Setting

The study was conducted in the urban area of San Jose, Occidental Mindoro. The areas included were Brgy. Pag-asa, Brgy. Caminawit, Labangan, San Roque, Murtha, Central, Brgy. 3, Brgy. 4, and Brgy. 5. The researchers gathered the data needed from the location where saturation of grocery stores was visible.

Unit of Analysis and Sampling

The respondents of the study were the employees of the local grocery stores in San Jose, Occidental Mindoro. The list of the grocery stores was taken from the Municipal Office of the Local Government Unit (LGU) of San Jose, Occidental Mindoro. The list has a total of 65 grocery stores offering different products to the customer. The researchers opted for simple random sampling. From a total of 65 stores only 10 stores passed the system requirements of digital transformation adoption, these stores have a Point of Sale (POS) system, RFIDs, and Barcode Scanning Devices used in their day-to-day operations. These stores have a total of 205 employees with a prevalence level that can estimate maximum sample size (50%), marginal error (d) 0.05, and with 95% confidence interval certainty were considered. Based on these, a total sample size was 134 based on RaoSoft result, the survey was conducted in San Jose, Occidental Mindoro. The study took the grocery store owners, managers, and employees registered in the locality of San Jose, Occidental Mindoro as respondents of the study from a total of 65 stores only 10 stores passed the system requirements of digital transformation adoption, these stores have a point of sale (POS) system, RFID's, and barcode scanning devices used in their day-to-day operations.

Research Instrument

The researchers utilized a researchers-made survey questionnaire based on the related literature and studies. The instrument was consisted of two parts. The first part of the questionnaire was to determine the adoption of digital technologies, while the second part identified the extent of operations of grocery stores in terms of inventory management, marketing, supply chain, human resource management, and capacity management. The researchers used Likert's format for the questionnaire wherein the respondents were asked to rate whether the statements are agreeable in a scale of 1 to 4 having 4 as the highest which means that they strongly agree and 1 as the lowest which means that the respondents strongly disagree. The questionnaire has undergone validation with the experts from the field of business management.

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The Cronbach's alpha coefficient of .948 obtained from the reliability test is consistently excellent, indicating a remarkable degree of internal consistency among the items comprising the scale. This result suggests that the items in the questionnaire consistently measure the same underlying construct or trait. Participants' responses to each item are highly correlated, indicating a strong level of consistency within the scale. As a result, researchers can have high confidence in the reliability and stability of the instrument.

Data Collection Procedure

Upon approval of the request letter by the appropriate authorities, the researchers proceeded with the data collection phase of the study. The questionnaires were personally distributed to the identified respondents to ensure that each participant received proper instructions and clarifications regarding the content and purpose of the survey. The researchers explained the objectives of the study, assured the respondents of the confidentiality of their responses, and emphasized that participation was voluntary. After giving the respondents ample time to accomplish the questionnaires, the researchers personally collected the completed forms to ensure a high retrieval rate and to address any incomplete or unclear responses.

Data Processing and Analysis

Descriptive statistics, including the mean and standard deviation, were employed to summarize and describe the characteristics of the data. To address the inferential aspect of the study, Pearson product-moment correlation coefficient (Pearson r) was utilized to determine the strength and direction of the relationship between the variables under investigation.

Ethical Considerations

The survey questionnaire begins with a letter to the respondents explaining the study's scope and purpose. Informed consent also ensured that respondents' identities would be kept anonymous. According to the ethical research standards and the Data Privacy Act of 2012, they will keep the information they provide confidential (Republic Act No. 10173). The researchers explained that the results of this study will be treated with utmost confidentiality, and will only be used for academic purposes. All gathered information by the researchers was properly disposed of following applicable data privacy procedures.

The study followed the necessary protocols, which include obtaining permission from the appropriate authorities. The subjects of the study were briefed on the scope of their expected participation; however, they were assured of the anonymity of all details about their identity, as the data or information obtained from the study was used for investigation. Furthermore, they properly acknowledged all sources or references used in this paper by citing them in the text or the bibliography. Furthermore, the researcher stated that there was no conflict of interest in the study and that the study's adopted mantra or guiding principles would undoubtedly be impartiality in acknowledging the results. Furthermore, throughout this investigation, honesty and unbiased reporting, as well as respect for human life, were strictly adhered to. It is in terms of giving in to whatever benefited the subjects.

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RESULTS

The Extent of Digital Transformation Adoption of Grocery Stores.

The results shows that the digital transformation adoption is highly perceived by the respondents (3.68±.156). This result was reflected from the high extent in each parameter such as: product (3.88±.211), manpower knowledge and skills (3.56±.251), The items, Digital transformation has positively impacted the overall competence and adaptability of the workforce (3.69±.466), customer engagement (3.56±.225), and market analysis (3.68±.156) [Table 1].

Table 1. The extent of digital transformation adoption of grocery stores.

ITEM	MEAN	SD
Product	3.88	.211
Manpower Knowledge and Skills	3.56	.251
Customer Engagement	3.56	.225
Market Analysis	3.70	.274
GRANDMEAN	3.68	.156

Legend: to a very low level (: 1.00 – 1.75); to a low level (1.76-2.50); to a high level (2.51-3.25); to a very high level (3.26-4.00)

The Extent of Operations in Grocery Store

The results show a high extent of operations in grocery stores (3.66±.240). Further it was observed a very high extent on inventory management (3.71±.290), supply chain (.65±.512), human resource management (3.63±.515), capacity management (3.70±.279) [Table 2].

Table 2. The extent of operations in grocery stores.

ITEM	MEAN	SD
Inventory Management	3.71	.290
Marketing	3.64	.317
Supply Chain	3.65	.370
Human Resource Management	3.63	.315
Capacity Management	3.70	.279
GRANDMEAN	3.66	.240

Legend: to a very low level (: 1.00 – 1.75); to a low level (1.76-2.50); to a high level (2.51-3.25); to a very high level (3.26-4.00)

Significant Relationship between the Digital Transformation Adoption and Operations of Grocery Stores

Table 4 presents the significant relationship between the digital transformation adoption and its operation. It shows that there is a moderately positive relationship between the two variables (P – value of < .01, F – value = .607). The moderately positive relationship indicates that, when the digital transformation adoption increases or high, then there is an increase in their operations [Table 3].

Table 5. Relationship between digital transformation adoption and operation in grocery stores.

Variables	M	SD	1	2
1. Digital transformation adoption	3.68	.156	-	
2. Operations	3.66	.240	.607**	-

***. Correlation is significant at the 0.01 level (2-tailed).*

DISCUSSION

The Extent of Digital Transformation Adoption

Based on the results, the digital transformation adoption viewed transitioning to digital operation positively. This indicates that these advancements are making notable impact to their businesses. While, the result grand mean and its standard deviation imply a positive and consistent view of the grocery stores to the digital transformation adoption. Moreover, these results provide insight on the perceived effectiveness of these strategies to the operation's performance of these grocery stores. The research findings show that digital transformation is expected to change organizations across many different fronts as almost all business model constructs have at least one element that is expected to change moderately or even stronger. The greatest impact will be to organizations' their value proposition, the customer segments they can identify and serve, the way organizations reach their customers, and the resources they use (Liang & Tian, 2024).

More so, the variables indicated a very high level of digital transformation adoption in grocery stores, particularly in enhancing product-related aspects. These findings underscore the significant role of digital technologies in improving convenience, accessibility, and the overall shopping experience for customers. The availability of online catalogs provides convenience for customers to browse and select products remotely. This aligns with the notion that digital formats enhance accessibility, as suggested by Kamble et al. (2019). This corresponds with the integration of digital technologies to enhance product accessibility, as discussed by Verhoef et al. (2019). The availability and accessibility of the customers to price checkers and barcode scanning devices could be of great convenience, that would help them explore a wide range of products in the stores without having the hesitation to pay for it when already in the counter since price could be checked ahead of it.

Based on the findings, it was found that the employees of the grocery stores are equipped with a decent knowledge on how the digital technologies or tolls are being used in their operation. It implies that the employees are adaptive and flexible when it comes to changes in their work. However, it also shows that an improvement to their practice can still be done in order to efficiently do their job using digital tools. They may acquire a skill set that would cater their digital literacy, data analytics, and cybersecurity (Imjai et al., 2024).

Based on the findings, the respondents have positively agreed on the operations of the grocery stores. This implies that the grocery stores have been able to manage their operation

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in terms of inventory management, marketing, supply chain, huma resource management, and capacity management processes. As for inventory management by adopting digital transformation, it implies that there is a general acknowledgement on their operations in San Jose, Occidental Mindoro. It indicates that this variable is not just seen as advantageous but rather play significant role to the adaptability and flexibility of the business to the inevitable conditions brought by the changing business environment.

The adoption of digital transformation initiatives profoundly impacts inventory management practices, offering businesses numerous benefits ranging from enhanced visibility and real-time tracking to improved forecasting and demand planning. By streamlining operations, reducing costs, fostering innovation, and promoting adaptability, digital transformation serves as a catalyst for business growth and competitiveness in today's digital era (Fang et al., 2024). Thus, the standard deviation of operations suggests of a low dispersion of the data around the responses of the inventory management of grocery store. This implies that there is a relatively high consensus amongst the answers of the respondents.

Furthermore, the result in marketing as a parameter of grocery store operations suggests a high and favorable perception of the respondents in the role of its operation. This shall indicate the recognition of the significance of streamlined and efficient marketing process. The moderate variability or dispersion on the answers of the respondents was also shown. It shows that the responses varied accordingly and differences on their answers were found. However, digital transformation has revolutionized marketing strategies in grocery stores, enabling enhanced personalization, mobile app development, loyalty programs, omni-channel marketing, dynamic pricing, and promotions.

Similarly, supply chain contributes relevantly on the operations of grocery store. This result implies that the grocery stores were able to manage their supplies needed depending on the demand of their customers with the use of technology. The grocery stores were able to adapt digital transformation in order to manage demands and products that would fit with the preferences and needs of its customers. Thus, Digital transformation is shaping the latest supply chain management trends. Digital solutions improve access to supplier and consumer data, empowering organizations to make more informed decisions. Many factors drive digital transformation, from advanced data analytics to artificial intelligence (AI) and automation. Digital tools and software can boost efficiency and agility, all while reducing operational costs. In turn, supply chain organizations can become more resilient and agile when facing disruptions (Ning & Yao, 2023).

It can be noted that the grocery stores were able to strategically align its transformation practices but not to the highest extent. This may be due to some other factors like availability of resources and knowledge required for business transformation. Also, the standard deviation presents a low variability among the responses which indicates the

consistent or similar view of the respondents on the role of transformation in staying agile amidst of the challenges and changes happening in the market. Regardless of the magnitude of an HR transformation, digital or otherwise, success can only be achieved when a clear goal is established. Such changes must make financial sense to ensure long-term viability and growth. Human resource management digital transformation enables organizations to increase efficiency, reduce costs, and improve the employee experience.

Thus, the result in capacity management is viewed positively in San Jose, Occidental Mindoro suggesting that the organization is also performing well in this aspect. Effective capacity management ensures optimal resource utilization and can contribute to overall operational efficiency. This indicates that the grocery stores may have strategies in place for managing its supply chain activities. This allows the grocery stores to optimize capacity management processes, reducing manual effort and improving operational efficiency. Digital transformation has a profound impact on capacity management, enabling organizations to improve resource allocation, enhance operational efficiency, and drive business success. By leveraging real-time data visibility, automation, collaboration, and scalability, organizations can optimize capacity management processes to meet changing market demands while minimizing costs and maximizing efficiency. In today's dynamic and competitive business environment, digital transformation is essential for organizations looking to stay agile, resilient, and competitive in managing their capacity effectively (Zhao, N., & Ren, J., 2023).

The moderately positive relationship indicates that, when the adaptation of digital transformation increases or high, then there is as well a corresponding increase in grocery store operations performance. This implies that adapting or transitioning to digitalization can contribute to the effective and efficient operations of grocery stores to the changing business environment. This suggests that technology is a relevant asset of a business that could fosters innovation, efficiency, cost effectiveness, and overall competitive advantage within the market. Technology is used as a business strategy to improve marketing effectiveness and to increase more its performance and by keeping the business costs checked and reduced (Pascucci et al., 2023).

In summary, the relationship between digital transformation and the operation of grocery stores is significant. With the adoption of e-commerce, retail grocery stores can better manage customer experience, improves inventory management, enables personalized marketing, optimizes supply chains, boosts operational efficiency, facilitates data-driven decision-making, and provides a competitive advantage. Embracing digital technologies is crucial for staying competitive and meeting the evolving needs of customers in today's digital age (Wolniak et al., 2024).

CONCLUSION

Based on the research findings, there is a relatively very high extent of digital transformation adoption was found in the study. This concludes that the adoption has a favorable and positive view on the effectiveness and benefits of digital transformation in maintaining its quality products, efficient manpower, effective customer engagements, and top brass market analysis. Result shows a positive agreement of the respondents on the indicator of grocery stores' operations. Therefore, this recognizes the relevance of managing well their inventory, implementing marketing strategies, supply chain, and their capacity. These actions may lead to their business stability and sustainability. The positive relationship between the adoption of digital transformation and grocery stores' operation implies the significance of utilizing technology in the day-to-day business activities, making them stay competitive and relevant in ensuring customers' convenience and satisfaction.

Based on the research findings, it is suggested that the grocery stores may improve their evaluation and feedback system by using digital platform like chatbots that would automatically answer the customers queries about the business. The grocery stores may enhance its marketing efforts in order to improve its sales performance where they can look for possible collaborations with various agencies like Department of Trade and Industry and higher education institutions for a possible conduct of trainings and workshops about marketing. The findings also suggests that the grocery stores may still engage in advancing the digital tools that they are using to competitively operate in the constantly changing business environment. Also, the other grocery stores may also purchase digital tools as the findings proved that the use of digital tools could positively affect their business operation.

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REFERENCES

Ali, B. J. (2020, October 25). Impact of COVID-19 on consumer buying behavior toward online shopping in Iraq. *Algerian Scientific Journal Platform*. 14(3). 267-280. https://asjp.cerist.dz/en/article/134070

Eger, L., Komárková, L., Egerová, D., & Mičík, M. (2021). The effect of COVID-19 on consumer shopping behaviour: Generational cohort perspective. *Journal of Retailing and Consumer Services*, 61, 102542. https://doi.org/10.1016/j.jretconser.2021.102542

Fang, Y., Zhou, Q., Jiang, X., & Li, C. (2024). Unlocking the potential of inventory management: Integrating digital transformation with firm practices. *Economic Modelling*, 139, 106841. https://doi.org/10.1016/j.econmod.2024.106841

Hultman, J., & Egan-Wyer, C. (2022). Physical retailing vs. physical distancing – an empirical study of Swedish retail adaptations in the wake of Covid-19. *The International Review of Retail*

Distribution and Consumer Research, 32(2), 201–220. https://doi.org/10.1080/09593969.2022.2047760

Imjai, N., Aujirapongpan, S., & Yaacob, Z. (2024). Impact of logical thinking skills and digital literacy on Thailand's generation Z accounting students' internship effectiveness: Role of self-learning capability. *International Journal of Educational Research Open*, 6, 100329. https://doi.org/10.1016/j.ijedro.2024.100329

Kamble, S. S., Gunasekaran, A., & Gawankar, S. (2019). Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications. *International Journal of Production Economics*. https://doi.org/10.1016/j.ijpe.2019.05.022

Kullak, F. S., Baier, D., & Woratschek, H. (2022). How do customers meet their needs in in-store and online fashion shopping? A comparative study based on the jobs-to-be-done theory. *Journal of Retailing and Consumer Services*, 71, 103221. https://doi.org/10.1016/j.jretconser.2022.103221

Liang, D., & Tian, J. (2024). The Impact of Digital Transformation on the High-Quality Development of Enterprises: An Exploration based on Meta-Analysis. *Sustainability*, 16(8), 3188. https://doi.org/10.3390/su16083188

Ning, L., & Yao, D. (2023). The impact of digital transformation on supply chain capabilities and supply chain competitive performance. *Sustainability*, 15(13), 10107. https://doi.org/10.3390/su151310107

Pantano, E., Pizzi, G., Scarpi, D., & Dennis, C. (2020). Competing during a pandemic? Retailers' ups and downs during the COVID-19 outbreak. *Journal of Business Research*, 116, 209–213. https://doi.org/10.1016/j.jbusres.2020.05.036

Pascucci, F., Savelli, E., & Gistri, G. (2023). How digital technologies reshape marketing: evidence from a qualitative investigation. *Italian Journal of Marketing*. https://doi.org/10.1007/s43039-023-00063-6

Verhoef, P. C., Kannan, P., & Inman, J. J. (2015). From Multi-Channel retailing to Omni-Channel retailing. *Journal of Retailing*, 91(2), 174–181. https://doi.org/10.1016/j.jretai.2015.02.005

Wolniak, R., Steculа, K., & Aydın, B. (2024). Digital Transformation of Grocery In-Store Shopping-Scanners, Artificial intelligence, Augmented Reality and beyond: A review. *Foods*, 13(18), 2948. https://doi.org/10.3390/foods13182948

Zhao, N., & Ren, J. (2023). Impact of enterprise digital transformation on capacity utilization: Evidence from China. *PLoS ONE*, 18(3), e0283249. https://doi.org/10.1371/journal.pone.0283249

ADOLESCENTS' INTENTION TO ENGAGE IN SCHISTOSOMIASIS PREVENTIVE BEHAVIORS: AN APPLICATION OF PROTECTION MOTIVATION THEORY IN AN ENDEMIC MUNICIPALITY IN ORIENTAL MINDORO

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ABSTRACT

In tropical and subtropical countries, schistosomiasis is a neglected tropical illness that typically affects impoverished rural communities, particularly those with agricultural and fishing populations. Victoria being one of the endemic Municipalities in Oriental Mindoro, adolescents are at risk of infection due to their cognitive and physical development stage. This study investigated adolescents' intention to engage in schistosomiasis preventive behaviors in endemic communities of Victoria, Oriental Mindoro, Philippines, using the Protection Motivation Theory (PMT). A descriptive correlational design was employed among 338 adolescents aged 12-19 from 13 barangays. Results indicated a low level of schistosomiasis knowledge among adolescents, with 78.7%. However, they demonstrated a "likely" intention to adopt protective measures in both short-term (3.75±1.14) and long-term (3.81±1.16) scenarios. Adolescents perceived high severity (3.47±0.96) and vulnerability (3.55±1.06) to schistosomiasis, showing strong awareness of the threat. Intrinsic and extrinsic rewards, and response cost, presented neutral scores, suggesting mixed perceptions. Significant correlations were found between PMT constructs and behavioral intentions. Severity, vulnerability, response efficacy, and self-efficacy significantly correlated with both short-term and long-term intentions. The study highlights the need for targeted health education interventions, leveraging social media and healthcare providers, to enhance knowledge and translate awareness into consistent preventive behaviors among adolescents in schistosomiasis-endemic areas.

Keywords: *adolescents, behavioral intention, endemic communities, protection motivation theory, schistosomiasis*

SDG: *SDG 3: Good Health and Well-being*

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INTRODUCTION

Schistosomiasis is one of the neglected tropical diseases commonly found in tropical and subtropical regions that affects approximately 240 million people worldwide, with more than 700 million people living in endemic areas in 78 countries. It usually affects poor rural areas, especially agricultural and fishing populations. Schistosomiasis *Japonicum* is an intestinal schistosomiasis highly endemic in 28 out of 81 states and distributed in 12 out of 18 regions (WHO, 2020).

The Philippines recorded about 12 million people in 1,599 barangays which are at risk of infection, and 2.5 million people are directly exposed to 3,012 slug-infested bodies of water, which makes S. *japonicum* a serious national public health problem. Oriental Mindoro, having 4 endemic municipalities, 33 barangays, and 44,528 populations were recorded endemic with this disease. Moreover, Victoria is out of the 4 endemic municipalities with 13 endemic barangays documented with a total number of 256 positive cases which is characterized by a high transmission rate brought by the continuous rainfall and subsequent floods which facilitate the spread of schistosomiasis (Municipal Epidemiology and Surveillance Office Victoria, 2020). Given the widespread prevalence of schistosomiasis in endemic areas, certain populations face a higher risk of infection. Adolescents are at increased risk of infection because they're in the stage of imbalance between cognition and physical development. More risk-taking and less protective behavior is expected among adolescents living where schistosomiasis is endemic.

Adolescents tend to do swimming, bathing, washing, and other recreational activities in places where schistosomiasis is endemic. Aside from its general health impact, schistosomiasis also poses serious reproductive health risks, particularly for women. Since schistosomiasis penetrates the skin of the human body in contact with water it can reside in blood vessels of humans and it can form disease in women. Eggs can be deposited in the tissue of the cervix and lower female genital tract that can lead to intravaginal lesions resulting genital itching, pain, bleeding as well as dyspareunia. Moreover, eggs deposited in the uterus and fallopian tubes can lead to infertility (Klohe et al., 2021; Xiao et al., 2016). Additional high-risk factors, such as children's play habits, insufficient sanitation facilities, and poor hygiene, have made people more vulnerable to getting the parasite. There have also been reports of anemia, hunger, growth retardation, poor cognitive function, and mortality connected to S. Infections with japonicum were also reported.

Effective disease management relies on accurate detection and prevention strategies. To date, schistosomiasis has been identified using procedures such as ultrasonography, polymerase chain reaction, circumoral precipitin test, and enzyme-linked immunosorbent assay, all of which have higher sensitivity and specificity. Furthermore, eDNA detection helps with surveillance, resulting in an integrated, multidisciplinary, "one health" approach to disease prevention and eradication (Chan et al., 2021). Schistosomiasis infection could be reduced by improving sanitation, informing those infected with schistosomiasis not to defecate on freshwater, lakes, rivers, and canals, and advising people living in endemic areas to wear foot protection when visiting infected sites, always participating in a government's Mass Drug Administration Program, and examining stool (Kato Katz) to determine if they are infected with schistosomiasis. With the alarming impacts associated with schistosomiasis, this study aimed

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to assess the knowledge and protective behavior of adolescents related to schistosomiasis infection and to enhance their awareness. Specifically, (1) to determine the characteristics of adolescents; (2) to describe the level of knowledge on schistosomiasis; (3) to describe the intention to take protective measures against schistosomiasis; (4) to describe the protective motivation; (5) to test the correlation between protection motivation with knowledge and intention to take protective measures against schistosomiasis.

METHOD

Study Design

The study used a descriptive correlational design to determine the respondent's characteristics, level of knowledge, and level of intention. Moreover, descriptive correlation would employ to explain the relationship between adolescents' characteristic knowledge and their intention to take protective measures against schistosomiasis.

Study Setting

The study was conducted in 13 *Barangays* of Municipality of Victoria, Province of Oriental Mindoro which are Bethel, Canaan, Duongan, Liedo, Malabo, Pakyas, Poblacion I, Poblacion II, Poblacion III, San Gelacio, San Isidro, San Narciso, and Urdaneta. The research was conducted on these places as it is known to be endemic for schistosomiasis. The risk of exposure to schistosomiasis is significantly higher in these communities because of surrounding bodies of water like the Naujan Lake, rivers, and some are irrigated rice fields making it endemic to schistosomiasis due to the presence of freshwater bodies that provide a suitable habitat for the intermediate host of the Schistosoma parasite–freshwater snails.

Unit of Analysis and Sampling

The data was collected between March 2024 and April 2024. Participants were adolescents within the 13 endemic *barangays* in the locality of Victoria. From a total adolescent population of 5,759 based on the 2024 census provided by the Municipal Planning and Development Office of Victoria, the researchers used OpenEpi version 3 open-source calculator, with a 95% confidence level, and they used stratified random sampling to select 338 samples drawn from a population of adolescent respondents of the study. The researcher stratified the population by site/location, creating 13 strata representing the 13 communities. A stratified sampling was utilized to choose subjects within each 13 groups, selecting a roughly equal representation of the population. The respondents in this study are considered vulnerable populations due to their status as adolescents living in endemic communities affected by schistosomiasis.

Research Instrument

The adolescent's demographic profile, which includes age, sex, educational attainment, place of living, and information source, was utilized by the researcher.

Using PMT (Xiao et al., 2016), which consists of seven components arranged as two group (the threat appraisal pathway and the coping appraisal pathway) connecting perceptions to behavior, the intention of adolescents to participate in protective behavior was measured. The

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four elements that make up the threat appraisal pathway are divided into two groups: intrinsic rewards and extrinsic rewards, severity and vulnerability. The self-efficacy, response costs, and response efficacy subconstructs are the three subconstructs that make up the two groups of the coping appraisal route. The primary technique for gathering data for this study was the PMT questionnaire. Adolescents from 13 endemic barangays (communities) in the Municipality of Victoria, Oriental Mindoro were surveyed using this tool. The researcher used the PMT questionnaire as the main vehicle to gather data for this research. The research instruments in this study were survey forms used to capture the answers of the adolescents within the 13 endemic barangays in the locality. To determine the correlation between the socio-demographic profiles of the respondents to the schistosomiasis infection.

Data Collection Procedure

The study employed a survey method using structured questionnaires to collect data from adolescents residing in 13 endemic barangays. The data collection period spanned from March 2024 to April 2024. Prior to the administration of the survey, the researchers followed a systematic data-gathering procedure to ensure ethical compliance and accuracy in data collection.

Before conducting the survey, the researchers coordinated with barangay officials and local health workers to facilitate community engagement and respondent identification. An initial orientation session was held to explain the purpose of the study, the significance of the research, and the procedures involved in data collection. The researchers secured informed consent from the parents of respondents before administering the questionnaires. As minors, they are particularly vulnerable to coercion and may have limited capacity to fully understand the research process, its potential risks, and benefits, thus, respondents were informed of the contents of the survey form, the study's objectives, the voluntary nature of participation, confidentiality measures, and the rights of the respondents, including their right to withdraw at any time without consequences. The surveys were conducted in a face-to-face setting per barangay, ensuring that respondents fully understood the questions. Researchers provided guidance when necessary while maintaining neutrality to prevent response bias. The collected questionnaires were reviewed on-site for completeness before being securely stored for further analysis.

Data Processing and Analysis

The survey data was manually entered into the computer after a quality check using Microsoft Excel. The double-entry protocol was imposed to minimize data-entry errors. Discrepancies from double entries were resolved by consulting the hard copies of the originally completed questionnaires. Frequency and percentage were used to summarize the sample characteristics. Pearson correlation coefficients were computed to assess the relationship among the variables for structural equation modeling analysis with a p-value of 0.05

Ethical Considerations

Several ethical considerations were carefully addressed to ensure the rights and welfare of participants are protected. First, the survey protocol was approved by the Institutional Research Board of Occidental Mindoro State College, San Jose Occidental Mindoro.

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First, informed consent was essential for the study, particularly because it involved adolescent participants. The study ensured that participants, as well as their parents or guardians, were fully informed about the research purpose, procedures, potential risks, and benefits before agreeing to participate. Written consent was obtained from parents or guardians of participants, in accordance with ethical guidelines for research involving minors.

Additionally, the confidentiality and privacy of the participants were safeguarded by assigning unique identifiers to all survey data and ensuring that no personal information was disclosed without explicit consent. Data were stored securely, and access was restricted to researchers only. Participants were also informed that their participation was voluntary and that they could withdraw from the study at any time without any consequences. The study was conducted with the utmost respect for the participants' dignity, privacy, and well-being while contributing meaningful knowledge to the field of health behavior. Special attention was also paid to minimizing any potential risks associated with their involvement in the study.

RESULTS

Table 1. Demographic characteristics

	Profile	Frequency	Percentage
Sex	Male	165	48.8
	Female	173	51.2
Age	12 – 15 y/o	227	67.16
	16 - 19 y/o	111	32.84
Educational Level	Elementary level	81	24.0
	High school level	175	51.8
	Senior high school level	70	20.7
	College level	11	3.3
	Out-of-school youth	1	.3
Place of Living	Near Naujan Lake	57	16.86
	Near Rivers	229	67.75
	Near Irrigated Rice Fields	52	15.39
Sources of Schistosomiasis Information	Social media	128	12.8
	Mass media	16	1.6
	Health agencies	122	12.2
	Healthcare providers	95	9.5
	Family/ friends	4	.4

The findings show that respondents of the study are slightly more females (51.2%) than males (48.8%), indicating a low level of gender bias. The majority of responders are young (67.16%) and are in high school (51.8%). Participants living near rivers (67.75%) have the most participation with social media (12.8%) as the most prevalent source of knowledge on schistosomiasis [Table 1].

Results reveal a low level of general knowledge about schistosomiasis among respondents. It shows that the majority of participants (78.7%) had a low level of knowledge,

while a smaller proportion (18.9%) demonstrated a medium level of knowledge. Only 2.4% of participants exhibited a high level of knowledge [Table 2].

Table 2. Level of knowledge on schistosomiasis among adolescents in the Municipality of Victoria, Oriental Mindoro.

Level of Knowledge	Frequency	Percentage
High	8	2.4
Average	64	18.9
Low	266	78.7

Findings show that with short-term intentions, respondents are likely (3.75±1.14) to avoid contact with snail-conditioned water, using protective measures when necessary. Long-term showed (3.81±1.16) likely intention to take protective measures over the long term [Table 3].

Table 3. Intention to take protective measures against schistosomiasis among adolescents in the Municipality of Victoria, Oriental Mindoro.

Intention to Take Protective Measures	Mean	SD
Short-Term (3 Months)	3.75	1.14
Long Term (12 Months)	3.81	1.16

Scale: 1.00-1.79 (Very Unlikely); 1.80-2.59 (Unlikely); 2.60-3.39 (Unsure); 3.40- 4.19 (Likely); 4.20-5.00 (Very Likely)

Result shows a strong awareness of the disease's severity and vulnerability among adolescents. They generally agree that schistosomiasis can cause significant health problems and that their families would suffer if they were infected. The severity (3.47±0.96), vulnerability (3.55±1.06), response efficacy (3.46±1.00) and self-efficacy (3.51±1.11) are highly agreed. While neutral scores indicate that the respondents showed intrinsic reward (2.99±1.00), extrinsic reward (2.85±1.03) and response cost (2.99±1.03) [Table 4].

Table 4. The protective motivation of Schistosomiasis among adolescents in the Municipality of Victoria, Oriental Mindoro.

Protective Motivation	Mean	SD
Severity	3.47	.96
Vulnerability	3.55	1.06
Intrinsic Reward	2.99	1.00
Extrinsic Reward	2.85	1.03
Response Efficacy	3.46	1.00
Self-Efficacy	3.51	1.11
Response Cost	2.99	1.03

Scale: 1.00-1.79 (Strongly Disagree); 1.80-2.59 (Disagree); 2.60-3.39 (Neutral); 3.40 4.19 Agree 4.20-5.00 (Strongly Agree)

In further analysis, threat appraisal constructs show a strong correlation between severity and vulnerability ($r = .702$, $p < 0.01$), while intrinsic and extrinsic rewards are also positively correlated ($r = .495$, $p < 0.01$). Severity is significantly associated with short-term

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behavior intention (r = .646, p < 0.01) and long-term protective behavior intention (r = .577, p < 0.01). Similarly, vulnerability correlates strongly with short-term (r = .709, p < 0.01) and long-term behavior intention (r = .625, p < 0.01). Coping appraisal constructs show a strong correlation between response efficacy and self-efficacy (r = .723, p < 0.01), while response cost has a weaker but significant relationship with self-efficacy (r = .322, p < 0.01). Response efficacy and self-efficacy are both significantly associated with short-term (r = .570, r = .647, p < 0.01, respectively) and long-term behavior intention (r = .583, r = .636, p < 0.01, respectively). Response cost has weaker but significant correlations with short-term (r = .154, p < 0.01) and long-term behavior intention (r = .145, p < 0.01). Among predictor variables, self-efficacy (r = .647), severity (r = .646), vulnerability (r = .709), and response efficacy (r = .570) all significantly correlate with short-term behavior intention, while response efficacy (r = .583) and self-efficacy (r = .636) are strongly linked to long-term protective behavior intention [Table 5].

Table 5. The relationship between schistosomiasis PMT sub-contracts with behavioral measures of adolescents in Municipality of Victoria, Oriental Mindoro.

	Variables	2	3	4	5	6	7	8	9	10
1.	Severity	.702**	.200**	-.006	.543**	.602**	.317**	.011	.646**	.577**
2.	Vulnerability		.124*	-.098	.670**	.692**	.182**	.013	.709**	.625**
3.	Intrinsic Reward			.495**	.204**	.144**	.408**	.132*	.076	.077
4.	Extrinsic Reward				-.013	-.015	.433**	.076	-.083	-.088
5.	Response Efficacy					.723**	.291**	.039	.570**	.583**
6.	Self-Efficacy						.322**	-.046	.647**	.636**
7.	Response Cost							.118*	.154**	.145**
8.	Knowledge								.014	.078
9.	Short-term Behavior Intention									.791**
10.	Long-term Protective Behavior Intention									

***Correlation is significant at the 0.01 level (2-tailed).*
** Correlation is significant at the 0.05 level (2-tailed).*

Discussion

The study was specifically designed to investigate the characteristics of adolescents in endemic areas, their knowledge levels regarding schistosomiasis, and their attitudes towards protective behaviors using the constructs of Protective Motivation Theory. Awareness and preventive efforts should be targeted toward younger adolescents to establish early health-conscious behaviors. Adolescents in the area are at crucial educational stages where health awareness interventions can be most impactful. There may be a chance for focused educational initiatives given the high school age of the majority of participants given age as moderator of motivation (Xiao et al., 2014). The low percentage of out-of-school youth among the participants suggests that formal education plays a key role in providing health education and information dissemination. Since schistosomiasis is mainly spread through freshwater sources, the geographic location of these communities puts adolescents at a greater risk of exposure to the disease. This finding emphasizes the importance of improving environmental and water sanitation in high-risk areas to help reduce transmission. However, factors like environmental exposure and economic challenges make it harder for individuals to take protective measures (Lund et al., 2021).

Reliance on modern communication channels for health information, emphasizing the need for targeted health campaigns through social media and healthcare institutions. Traditional mass media and personal networks, such as family and friends, have only a limited influence in spreading awareness about the disease. The decreasing reliance on these traditional sources suggests a shift in how people access information (Bottemanne et al., 2021). To effectively reach communities, health agencies, and providers need to adjust their outreach strategies to match modern communication preferences (Assefa et al., 2021; Hambury et al., 2021; Parisi et al., 2019). Healthcare providers and personal networks play a vital role in raising awareness, suggesting that educational outreach should focus on more official channels. However, the results of our study showed that only a few have obtained information from healthcare providers, which could also be the cause of inadequate knowledge or misconceptions about schistosomiasis (Lwin et al., 2007).

The low knowledge levels suggest that existing health education efforts may be insufficient or not effectively reaching adolescents. Since knowledge is a key factor in influencing behavior, enhancing educational interventions is vital for increasing awareness and encouraging preventive actions. Health education programs should engage both schools and communities, equipping schoolchildren to act as messengers who share important health information within their communities (Musuva et al., 2014b).

The high level of awareness among participants indicates that educational campaigns have been somewhat effective in increasing knowledge about the disease. As suggested by the core principles of Protection Motivation Theory (PMT), individuals are more likely to take protective actions when they recognize both the severity of a threat and their own vulnerability to it (Xiao et al., 2014, 2016). Adolescents' strong belief in the effectiveness of preventive measures, along with their confidence in carrying them out, is a good indicator. This positive mindset suggests they are more likely to adopt protective behaviors. However, it is important to determine whether these beliefs actually translate into real-life actions. Challenges such as reliance on contaminated water sources and misunderstandings about mass drug administration (Anyolitho et al., 2022; Assefa et al., 2021) need to be addressed to ensure that awareness and intention lead to lasting behavioral change.

Adolescents have mixed feelings about whether avoiding infection brings them internal satisfaction (intrinsic reward) or external benefits (extrinsic reward). This contrasts with previous studies which stated that rewards can sometimes lead people to engage in risky behaviors instead (Floyd et al., 2000). As indicated, social media seems to serve as an extrinsic motivator for sharing health information, presenting a valuable opportunity to promote preventive behaviors through social recognition and community engagement.

The correlation analysis of Protection Motivation Theory (PMT) subconstructs reveals significant relationships between threat and coping appraisal constructs (Xiao et al., 2016). A strong correlation between severity and vulnerability suggests that adolescents who perceive Schistosomiasis as severe also acknowledge their susceptibility to infection. Furthermore, the positive correlation between intrinsic and extrinsic rewards implies that adolescents who find internal satisfaction in taking preventive measures also tend to recognize the external benefits.

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The strong correlation between perceived severity, vulnerability, and behavioral intentions indicates that those who see Schistosomiasis as a serious threat are more likely to adopt preventive behaviors (Marikyan et al., 2023). Similarly, coping appraisal factors show a strong connection between response efficacy and self-efficacy, meaning that those who trust in the effectiveness of preventive measures also feel confident in their ability to carry them out. The correlation between response efficacy, self-efficacy, and both short-term and long-term intentions emphasizes the need to build confidence in preventive behaviors. When adolescents trust that prevention is effective and feel capable of taking action, they are more likely to maintain protective habits over time.

CONCLUSION

The study explored several key aspects related to schistosomiasis among adolescents in the Municipality of Victoria, Oriental Mindoro which led to the following conclusions. There is a balanced distribution of males and females, a majority in the high school age range, and varying levels of educational attainment. The majority of them live near rivers which heightened the risk of exposure among these adolescents. The findings also highlighted the primary sources of information on schistosomiasis, with social media emerging as the most significant, suggesting a shift in how adolescents access health information. There is a low level of general knowledge about Schistosomiasis among respondents. Adolescents had varying intentions to adopt protective measures against schistosomiasis, with long-term intentions (6 months) generally being higher than short-term intentions (3 months).

The findings also reveal a strong correlation between different aspects of the Protection Motivation Theory (PMT) and their impact on both short-term and long-term intentions to engage in protective behaviors. In terms of threat appraisal, adolescents who felt more vulnerable to schistosomiasis and recognized its severity were more likely to consider taking preventive action. Similarly, those who found both personal satisfaction (intrinsic rewards) and external benefits (extrinsic rewards) in protective behaviors showed a positive link between these two factors.

When it came to coping strategies, confidence played a crucial role–adolescents who believed in the effectiveness of prevention (response efficacy) and felt capable of carrying it out (self-efficacy) were more likely to commit to protective behaviors, both in the short and long term. While concerns about barriers, such as cost or inconvenience, had a weaker influence, they still played a role in shaping behavior, suggesting that reducing perceived obstacles (barriers) could further encourage preventive action.

Based on the study findings, it is recommended that tailored interventions be developed to enhance preventive practices among adolescents in the Municipality of Victoria, Oriental Mindoro. These interventions should focus on increasing awareness by implementing targeted educational campaigns through social media and health agencies to improve knowledge about schistosomiasis and its prevention. Public health messaging should be strategically placed in digital and institutional health channels such as the social media page of the rural health unit of for maximum reach. One specific way to address potential barriers and reinforce the benefits of continuous protective behaviors is to implement a community-based program (CBP)

which may include distribution of free or subsidized protective footwear, gloves, and safe water containers to reduce direct exposure to contaminated water sources. Free deworming treatments and priority medical check-ups are also recommended.

The benefits of adopting preventive behaviors against schistosomiasis must be emphasized, highlighting the positive outcomes of protective measures. Training programs on proper hygiene, use of protective gear (e.g., footwear in contaminated water), and access to preventive treatment should be implemented. Programs should prioritize individuals who are most vulnerable, such as children, farmers, and those living near lakes, rivers, and irrigated rice fields. Additionally, the local government of Victoria should integrate protective measures with economic benefits, such as safe water initiatives for irrigation and alternative livelihood training (e.g., aquaculture in non-contaminated water sources). This ensures that communities still have access to income-generating activities without risking exposure to Schistosomiasis. By implementing these recommendations, stakeholders can effectively promote behavior change and improve health outcomes among adolescents in the Municipality of Victoria, Oriental Mindoro, in the fight against schistosomiasis.

REFERENCES

Anyolitho, M. K., Poels, K., Huyse, T., Tumusiime, J., Mugabi, F., Tolo, C. U., Masquillier, C., & Nyakato, V. N. (2022). Knowledge, attitudes, and practices regarding schistosomiasis infection and prevention: A mixed-methods study among endemic communities of western Uganda. *PLoS Neglected Tropical Diseases*, *16*(2), e0010190. https://doi.org/10.1371/journal.pntd.0010190

Assefa, A., Erko, B., Gundersen, S. G., Medhin, G., & Berhe, N. (2021). Low awareness and common misconceptions about schistosomiasis in endemic lowland areas in Western Ethiopia: a mixed-methods study. *BMC Public Health*, *21*(1). https://doi.org/10.1186/s12889-021-11106-y

Bottemanne, H., & Friston, K. J. (2021). An active inference account of protective behaviours during the COVID-19 pandemic. *Cognitive Affective & Behavioral Neuroscience*, *21*(6), 1117–1129. https://doi.org/10.3758/s13415-021-00947-0

Floyd, D. L., Prentice-dunn, S., & Rogers, R. W. (2000). A Meta-Analysis of Research on Protection Motivation Theory. *Journal of Applied Social Psychology*, *30*(2), 407–429. https://doi.org/10.1111/j.1559-1816.2000.tb02323.x

Hambury, S. D., Grobler, A. D., & Melariri, P. E. (2021). Knowledge, Attitudes, and Practices on Urinary Schistosomiasis among Primary Schoolchildren in Nelson Mandela Bay, South Africa. *Journal of Parasitology Research*, *2021*, 1–12. https://doi.org/10.1155/2021/6774434

Klohe, K., Koudou, B. G., Fenwick, A., Fleming, F., Garba, A., Gouvras, A., Harding-Esch, E. M., Knopp, S., Molyneux, D., D'Souza, S., Utzinger, J., Vounatsou, P., Waltz, J., Zhang, Y., & Rollinson, D. (2021). A systematic literature review of schistosomiasis in urban and peri-urban settings. *PLoS Neglected Tropical Diseases*, *15*(2), e0008995. https://doi.org/10.1371/journal.pntd.0008995

Lund, A. J., Sokolow, S. H., Jones, I. J., Wood, C. L., Ali, S., Chamberlin, A., Sy, A. B., Sam, M. M., Jouanard, N., Schacht, A., Senghor, S., Fall, A., Ndione, R., Riveau, G., De Leo, G. A., & López-Carr, D. (2021). Exposure, hazard, and vulnerability all contribute to Schistosoma

haematobium re-infection in northern Senegal. *PLoS Neglected Tropical Diseases*, 15(10), e0009806. https://doi.org/10.1371/journal.pntd.0009806

Lwin, M. O., & Saw, S. (2007). Protecting Children from Myopia: A PMT Perspective for Improving Health Marketing Communications. *Journal of Health Communication*, 12(3), 251–268. https://doi.org/10.1080/10810730701266299

Marikyan, D., & Papagiannidis, S. (2023). Protection Motivation Theory: A review. In S. Papagiannidis (Ed.), *TheoryHub Book:* This handbook is based on the online theory resource: TheoryHub (pp. 78-93) https://open.ncl.ac.uk/theory-library/TheoryHubBook.pdf

Musuva, R. M., Awiti, A., Omedo, M., Ogutu, M., Secor, W. E., Montgomery, S. P., Alaii, J., & Mwinzi, P. N. M. (2014). Community Knowledge, Attitudes and Practices on Schistosomiasis in Western Kenya-The SCORE Project. *American Journal of Tropical Medicine and Hygiene*, *90*(4), 646–652. https://doi.org/10.4269/ajtmh.13-0488

Parisi, S., Mazigo, H. D., Kreibich, S., Puchner, K., Kasang, C., & Mueller, A. (2019). Factors associated with relevant knowledge of intestinal schistosomiasis and intention to participate in treatment campaigns: a cross sectional survey among school children at Ijinga Island on Lake Victoria, North-Western Tanzania. *BMC Public Health*, *19*(1). https://doi.org/10.1186/s12889-019-8091-4

Xiao, H., Li, S., Chen, X., Yu, B., Gao, M., Yan, H., & Okafor, C. N. (2014). Protection Motivation Theory in Predicting Intention to Engage in Protective Behaviors against Schistosomiasis among Middle School Students in Rural China. *PLoS Neglected Tropical Diseases*, *8*(10), e3246. https://doi.org/10.1371/journal.pntd.0003246

Xiao, H., Peng, M., Yan, H., Gao, M., Li, J., Yu, B., Wu, H., & Li, S. (2016a). An instrument based on protection motivation theory to predict Chinese adolescents' intention to engage in protective behaviors against schistosomiasis. *Global Health Research and Policy*, *1*(1). https://doi.org/10.1186/s41256-016-0015-6

Zhang, K. (2019). Bridging the gap on schistosomiasis: A cross-sectional study examining the knowledge gap and common attitudes and practices regarding S. mansoni infections among varying education levels in Luanda K'Otieno, western Kenya. *SIT Digital Collections*. https://digitalcollections.sit.edu/isp_collection/3129/

YOUNG ADULTS' EXPOSURE TO SHORT-FORM VIDEOS AND ITS RELATIONSHIP TO EMOTIONAL STABILITY

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ABSTRACT

Short-form videos are one of the rising trends in social media, conveniently accessible, specifically to young adults. The constant exposure of the users allows them to be subject to possible changes in their emotional stability, risking their mental health. Based on various studies, emotional stability is a crucial predictor of mental health, making it a factor to consider in this study. The study involves 110 young adult college students to determine the relationship between exposure to short-form videos and emotional stability. Mainly, females between 18 and 20 consume short-form videos using Facebook as a platform. Additionally, the students' overall exposure to short-form videos was high. However, it is notable that the respondents' time spent watching short-form videos was low but high in viewing purposes. Although overall emotional stability was high, self-awareness was relatively low. The findings indicated no significant correlation between demographic factors and short-form video exposure; however, a positive relationship between the purpose of viewing videos and emotional stability was noted, despite no correlation between the duration of exposure and emotional stability. It highlights the possible association between intentional viewing, limited duration of consumption, and emotional stability among young adults.

Keywords*: emotional stability, exposure, short-form videos, viewing purposes, young adults*

SDG: *Goal 3: Good Health and Well-being*

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INTRODUCTION

The world is subjected to various fast-approaching changes, mainly relying on the spectrum of technological advancement. Being able to experience the first-hand effect of these changes makes us reliant on what it can do to elevate life. The development and advancement in technology have significantly proven to improve the lifestyle of individuals. Almost all aspects of life have been impacted by technology. It is said that the advancement of technology is directly proportional to time. As time increases, technological advancement is growing with it as well. Due to this, society utilizes its advantage by creating and developing it to enhance and extend individuals' lifespans. Contradictory, this widespread access to popular media forces researchers to provide countless studies examining the utilization and effects of social media on users' lives and health (Begum, 2018).

As technological advancement rapidly transformed lives, the popularity of short-form videos increased, resulting in short-form video applications like TikTok to emerge. It runs under 15 minutes, featuring brief content with a distinct theme. The popularization of short-length videos has become relevant in the present era. However, it also brought substantial disadvantages and risks (Chen et al., 2022). A study of Marin et al. (2020) revealed that excessively consuming applications using the internet poses a risk to a person's mental well-being, social connections, and condition of life. It gathered pronounced attention from mass media and researchers.

Furthermore, Twenge et al. (2019) explained that these popular media create trends, which is the reason why the mental health of adolescents and young adults continues to deteriorate. Gautam et al. (2024) raised concerns about the possible adverse effect of it on the mental well-being of the subjects, gaining attention in return. Additionally, according to Sivakumar et al. (2023), continuous exposure can influence individuals in various ways. Even though trends promote awareness, knowledge, and other positive educational approaches, they can also spread negative connotations to people following them.

The Philippines youth age range is 15-30 (Republic Act No. 8044), and this period of early adulthood is at risk when it comes to mental health (Braghieri et al. (2022). This stage of life is usually an individual facing pivotal changes and choices necessary in nurturing their future. Furthermore, young adulthood is the peak period embodied by various transitions like identity development and most mental illnesses influenced by personality (Cunningham and Duffy, 2019). As the role of emotional stability in an individual's personality traits serves as a vital piece of mental well-being and human existence (Maheshwari & Gujral, 2021).

Moreover, the study of Annisty and Agustina (2020) found that the duration of time spent on social media does not impact emotional stability. It holds considerable significance for researchers, as it provides an insight into the vast possibilities regarding the interfaces of the popular media. It serves as an opportunity for the researchers to do further investigation. Annisty and Agustina (2020) also suggest incorporating new indicators to explore the topic to address the existing gap. To address the gap, the researchers considered the length of exposure and their viewing purposes to assess the level of exposure of young adults to short-form videos.

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This study also aims to impart valuable insights concerning the association of short-form videos and emotional stability, laying the groundwork for succeeding studies and potential interventions in the field of guidance and counselling. In today's context, where the impact of social media keeps progressing, understanding its implications on young adults is of utmost importance.

METHOD

Study Design

This study utilized a quantitative and descriptive correlational research design to determine the possible relationship between the exposure of young adults to short-form videos and their emotional stability.

Study Setting

The study was conducted at Occidental Mindoro State College- Main Campus, San Jose Occidental Mindoro. Additionally, the respondents were young adult students in the College of Arts, Sciences, and Technology, taking courses available on the Main Campus.

Sample

This study involved young adult students of Occidental Mindoro State College in the College of Arts, Sciences, and Technology in San Jose, Occidental Mindoro using purposive sampling method.

Research Instrument

A modified survey questionnaire serves as the study research instrument. The emotional stability scale questionnaire was a modified version of Al-Masri and Ma'abreh (2020), and the exposure to short-form videos questionnaire. The modified questionnaires used in the study were validated for content validity by experts in the field of research. It followed recommendations and underwent revisions to be reliable and correct.

Data Collection

The data collection process utilized a questionnaire as the primary tool. It was distributed directly to the respondents in a pen-and-paper questionnaire. Respondents were approached in a manner that prioritized their willingness to participate and ensured confidentiality. Completed questionnaires were retrieved directly from the respondents to ensure the secure handling of collected data.

Data Analysis

The researchers used descriptive statistics to measure and interpret the exposure of students to short-form videos and their level of emotional stability. In discussing the demographic profile and other specific variables, the researchers used a weighted mean and frequency count. Lastly, for the interpretation of the potential relationship between exposure to short-form videos and evaluation of emotional stability, the researchers used Kendall's tau-b (τb) correlation coefficient.

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Ethical Considerations

The data collection process respected the rights and well-being of the respondents while maintaining the integrity of the research and strictly adhering to ethical boundaries and considerations. Before surveying respondents, the researchers provided informed consent, which outlined the benefits and purpose of the study. The risks of participating were also clearly stated. As the study focuses on mental health, it can be sensitive to some. In addition, the responders have the right to withdraw from the study. If they chose not to participate, the researchers replaced them with willing young adult students who also met the criteria set by the researchers. All the collected data was treated with utmost care and were not disclosed without the respondents' permission. Lastly, the data-gathering process followed the criteria set through purposive random sampling, maintaining a fair and consistent data-gathering procedure.

RESULTS

Table 1. Demographic profile of the respondents

Profile	Frequency	Percentage
Age		
18-20	79	71.8
21-23	29	26.4
24-26	1	.9
27-29	1	.9
Sex		
Male	21	19.1
Female	89	80.9
Use of Facebook to watch short-form videos		
Not Using	16	14.5
Using	94	85.5
Use of Instagram to watch short-form videos		
Not Using	65	59.1
Using	45	40.9
Use of TikTok to watch short-form videos		
Not Using	34	30.9
Using	76	69.1
Use of Youtube to watch short-form videos		
Not Using	61	55.5
Using	49	44.5
Access to short-form videos		
1 hour	36	32.7
2 hours	20	18.2
3 hours	28	25.5
4 hours and above	26	23.6

The results indicate that young adult students have a high overall exposure to short-form videos (mean = 2.54 ± 0.557). They are most exposed to entertainment videos (mean = 3.06 ± 0.339), followed by informative content (mean = 2.92 ± 0.342), while e-commerce videos had the lowest exposure (mean = 2.72 ± 0.286). Although their exposure duration is low (mean = 2.18, SD = 1.077), their high engagement with specific viewing purposes contributes to significant overall exposure [Table 2].

Table 2. Exposure to short-form videos.

Exposure to Short-form Videos	Mean	SD
Length of Exposure	2.18	1.077
Informativeness	2.92	.342
E-commerce	2.72	.286
Entertainment	2.76	.328
Weighted Mean	2.54	.557

Legend: very high (3.51-4.00); high (2.51-3.50); low (1.51-2.50); very low (1.00-1.50)

Based on the results, social skills received the highest rating (mean = 2.76±.328), followed by self-motivation (mean = 2.68±.341) and emotional control (mean = 2.66±.292). Self-awareness, however, ranked the lowest (mean = 2.47±.364). These results indicate that while respondents generally exhibit high emotional stability, their lower self-awareness suggests potential uncertainty in accurately understanding their emotional state (mean = 2.72±.198) [Table 3].

Table 3. Emotional stability of the respondents.

Emotional Stability of the Respondents	Mean	SD
Emotional Control	2.66	.292
Self-awareness	2.47	.364
Self-motivation	2.68	.341
Social Skills	2.76	.328
Emotional Stability of the Respondents	2.72	.198

Legend: very high (3.51-4.00); high (2.51-3.50); low (1.51-2.50); very low (1.00-1.50)

The results implies that the result of the correlation analysis among the independent variables (demographic profile) and dependent variables (emotional stability) have no positive correlation in between [Table 4].

Table 4. Correlation of respondent's profile and emotional stability.

Profile	Emotional Stability	
	r	p value
Age	-.018	.821
Sex	-.010	.900
Access to Short-form Videos	-.016	.829

***Correlation is significant at the 0.01 level (2-tailed)*
** Correlation is significant at the 0.05 level (2-tailed)*

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The table presents the correlation between respondents' exposure to short-form videos and emotional stability. The results show a significant positive relationship between viewing purposes and emotional control (r=.209, p-value =.004), as well as between viewing purposes and overall emotional stability (r=.143, p- value=.040). However, the length of exposure does not show a significant relationship with emotional stability (r=.030, p-value=.693). Consequently, the null hypothesis is accepted, indicating no significant relationship between the overall variables [Table 5].

Table 5. Correlation of respondent's profile and emotional stability.

Access to Short Form Videos	Emotional Stability	
	r	p value
Length of Exposure	-.030	.693
Viewing Purposes	.143*	.040
Overall Exposure	.012	.856

***Correlation is significant at the 0.01 level (2-tailed)*
** Correlation is significant at the 0.05 level (2-tailed)*

DISCUSSION

The study assessed the level of exposure of young adults to short-form videos and its relation to their emotional stability. It reveals that the respondents have high exposure to short-form videos and high emotional stability. It is also shown that there is a significant relationship between viewing purposes and emotional stability. However, the overall result suggests no significant relationship between the demographic profile, exposure to short-form videos, and emotional stability.

Results unveil that young adults can have high emotional stability despite their age, sex, or platform used in watching short-form videos. Moreover, their high level of exposure to short-form videos does not have a significant correlation to their low emotional stability. Instead, the findings indicate a positive relationship between emotional stability and the respondents' viewing purposes. It highlights that young adult students' choice, purpose, and intentions behind watching short-form videos may have a more relevant role compared to their length of exposure. Additionally, this may suggest an existing level of emotional maturity among the young adult respondents. It may be the reason why they are capable of maintaining better emotional control of their emotional responses. It is supported by the study of Khurshid and Khurshid (2018), which explored the capabilities of individuals to manage and maintain a certain level of emotional composure, leading them to manage mental disturbances or illnesses such as anxiety and depression. Display emotional stability in perceiving themselves, possibly due to their purposeful and balanced consumption of short-form videos.

Moreover, the findings may reflect that every young adult possesses characteristics and experiences associated with their inner traits that make them intellectually capable of regulating their emotions. Regardless of age, resiliency, which enables individuals to cope and

adapt, could be related to higher levels of emotional stability. Chen et al. (2023) stated that an individual's characteristics and emotional stability may have a better result in shaping the respondents compared to the variables listed under the demographic factors. Additionally, Maheshwari and Gurjal (2021) emphasized in their study that age does not limit someone's life experiences. Given that experiences shape emotional intelligence, emotional stability may also increase as they age. Also, conditions like genetics, personality, ethnicity, and socioeconomic conditions may have correlations with emotional stability (Annisty and Agustina, 2020).

Furthermore, cultural and social norms may be associated with emotional stability in young adults and could be factors considered alongside the existing demographic factor in this study. Khurshid and Khurshid (2018) explored the effects of cultures to emotional stability. Their study observed varying cultures and the result indicated that most of them expected individuals to hold back their emotions. In the lens of culture, females needed to be submissive and less stable handling their emotions. Contradictory, males are considered assertive and more emotionally stable. Additionally, Krys et al. (2021) revealed that different cultural norms, if positively expressed, can also be positively linked to the well-being of an individual, contributing to their emotional regulation and control.

Another factor to consider is the intention of the user when consuming short-form videos. Currently, these videos are in trend and relevant in the Philippines. The respondents' ability to attain high emotional stability despite high exposure suggests that it may be associated with their intentional watching of content. Individuals who watch short-form videos with motives such as seeking novelty, habit, pressure releasing, recording or sharing, and curiosity, even if subjected to high exposure to short-form videos, can result in positive outcomes as long as they are consuming videos based on their motives (Dong and Xie, 2022).

Moreover, new technologies can generate short-form videos based on the user's preferences and activities. Zhang et al. (2019) stated that short-form videos have features useful for making algorithms. It relies on the user's preferences, potentially reinforcing purposeful viewing experiences. This personalization may help the users to stay aligned with their intended viewing purposes.

The findings of this study also highlight the correlation between emotional control and emotional stability. Eldesouky and English (2018) emphasized how individuals regulate their emotions by considering the consistency and frequency of factors influencing their choices. In this situation, young adults with stable emotional control may be more intentional and careful in consuming digital content, navigating their needs like stress relief by watching entertaining short videos, or achieving specific goals like gathering information or educating themselves without the risks of having unstable emotions. It aligns with Millgram et al. (2018), who suggested that people frequently manage emotions to achieve goals. The observed positive correlation between viewing purposes, emotional control, and emotional stability in the study supports the idea that intentional consuming of short-form videos may be associated with higher emotional stability.

Lastly, the study included the length of exposure as a variable to consider for the overall exposure of the respondents. However, the result shows no significant relationship between the length of exposure and emotional stability, resulting in no correlation between the overall

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indicators. This finding is identical to the study of Annisty and Agustina (2020), which reported that there is no significant relationship between the length or duration of watching social media use and emotional stability. Their study suggests other aspects of social media, such as preferences or the type of content viewed. Implementing this suggestion introduces viewing purposes as an additional variable, providing a broader perspective on young adults' exposure to short-form videos. The results and findings of the study indicate a correlation or a potential link between viewing purposes and emotional stability, filling the research gap in the previous study. While these findings suggest a relationship between the variables, the link between viewing purposes and emotional stability is worthy of further investigation.

CONCLUSION

The study showed that the majority of respondents who used Facebook as a platform for watching short-form videos were aged 18-20 years old. The level of exposure in terms of length was low, while viewing purposes were high, resulting in a high overall interpretation. The level of emotional stability in terms of emotional control, self-motivation, and social skills was also high, while self-awareness was low, still resulting in a high overall interpretation. There is a significant relationship between the respondents' viewing purposes and emotional stability, while there is no significant relationship between length of exposure and emotional stability. Therefore, the null hypothesis is accepted.

Future researchers should be particular in choosing respondent criteria and expand their study by considering other settings and locations for a more diverse population. It is better to focus on one of the indicators of viewing purposes, as these can offer clearer insight into the existing research gap. Moreover, future researchers could examine the possible differences between the variables instead of determining whether there's a correlation between demographic profile and emotional stability. As this study showed a high level of emotional stability among selected students, the institution, especially the guidance and testing services, should promote more awareness by integrating psychological issues and provide activities and seminars for students to be aware and take care of their mental well-being

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REFERENCES

Al-Masri, A., & Ma'abreh, M. (2020). The Relationship between Emotional Stability and Self-Esteem among adolescents (Aged 13-16) in public schools in Irbid Qasabah. *Journal of Education and Practice*. https://doi.org/10.7176/jep/11-15-20

Annisty, M. A., & Agustina, N. (2020). The effect of duration of social media usage on emotional stability in undergraduate students. *Proceedings of the 2nd Tarumanagara International Conference on the Applications of Social Sciences and Humanities (TICASH 2020)*. https://doi.org/10.2991/assehr.k.201209.176

Begum, A. (2018). Technological advancement and the meaning of progress. *International Journal of Humanities and Social Science*, *5*(4), 64–70. https://doi.org/10.14445/23942703/ijhss-v5i4p112

Braghieri, L., Levy, R., & Makarin, A. (2022). Social media and mental health. *American Economic Review*, *112*(11), 3660–3693. https://doi.org/10.1257/aer.20211218

Chen, C., Chen, I., O'Brien, K. S., Latner, J. D., & Lin, C. (2021). Psychological distress and internet-related behaviors between schoolchildren with and without overweight during the COVID-19 outbreak. *International Journal of Obesity*, *45*(3), 677–686. https://doi.org/10.1038/s41366-021-00741-5

Chen, Y. N. (2023). The relationship between personality traits, emotional stability and mental health in art Vocational and Technical College students during Epidemic Prevention and Control. *Psychology Research and Behavior Management*, *Volume 16*, 2857–2867. https://doi.org/10.2147/prbm.s417243

Chen, Y., Li, M., Guo, F., & Wang, X. (2022). The effect of short-form video addiction on users' attention. *Behaviour and Information Technology*, *42*(16), 2893–2910. https://doi.org/10.1080/0144929x.2022.2151512

Cunningham, S., & Duffy, A. (2019). Investing in our Future: Importance of Postsecondary student Mental Health research. *The Canadian Journal of Psychiatry*, *64*(2), 79–81. https://doi.org/10.1177/0706743718819491

Dong, Z., & Xie, T. (2024). Why do people love short-form videos? The motivations for using Chinese TikTok (Douyin) and implications for well-being. *Current Psychology*, *43*(26), 22283–22296. https://doi.org/10.1007/s12144-024-05927-4

Eldesouky, L., & English, T. (2018). Another year older, another year wiser? Emotion regulation strategy selection and flexibility across adulthood. *Psychology and Aging*, *33*(4), 572–585. https://doi.org/10.1037/pag0000251

Gautam, S., Jain, A., Chaudhary, J., Gautam, M., Gaur, M., & Grover, S. (2024). Concept of mental health and mental well-being, it's determinants and coping strategies. *Indian Journal of Psychiatry*, *66*(Suppl 2), S231–S244. https://doi.org/10.4103/indianjpsychiatry.indianjpsychiatry_707_23

Khurshid Saba &Khurshid Shumaila, (2018). Emotional stability among college youth with reference to the gender. Sci.Int. (Lahore), 2018; 30(4): 615-618, https://www.indianjournals.com/ijor.aspx?target=ijor:ijmss&volume=4&issue=5&article=005

Krys, K., Yeung, J. C., Capaldi, C. A., Lun, V. M., Torres, C., Van Tilburg, W. a. P., Bond, M. H., Zelenski, J. M., Haas, B. W., Park, J., Maricchiolo, F., Vauclair, C., Kosiarczyk, A., Kocimska-Zych, A., Kwiatkowska, A., Adamovic, M., Pavlopoulos, V., Fülöp, M., Sirlopu, D., . . . Vignoles, V. L. (2021). Societal emotional environments and cross-cultural differences in life satisfaction: A forty-nine country study. *The Journal of Positive Psychology*, 17(1), 117–130. https://doi.org/10.1080/17439760.2020.1858332

Maheshwari, A. & Gujral, H. K. (2021). Emotional Stability: A Study of Contributory Factors. *International Journal of Indian Psychology*, *9*(4), 846-857. https://doi.org/10.25215/0904.083

Marin, M. G., Nuñez, X., & De Almeida, R. M. M. (2020). Internet Addiction and Attention in Adolescents: A Systematic review. *Cyberpsychology Behavior and Social Networking*, *24*(4), 237–249. https://doi.org/10.1089/cyber.2019.0698

Millgram, Y., Sheppes, G., Kalokerinos, E. K., Kuppens, P., & Tamir, M. (2018). Do the ends dictate the means in emotion regulation? *Journal of Experimental Psychology General*, *148*(1), 80–96. https://doi.org/10.1037/xge0000477

Sivakumar, A., Jayasingh, S., & Shaik, S. (2023). Social media influence on Students' knowledge sharing and learning: an Empirical study. *Education Sciences*, *13*(7), 745. https://doi.org/10.3390/educsci13070745

Twenge, J. M., Cooper, A. B., Joiner, T. E., Duffy, M. E., & Binau, S. G. (2019). Age, period, and cohort trends in mood disorder indicators and suicide-related outcomes in a nationally representative dataset, 2005–2017. *Journal of Abnormal Psychology*, *128*(3), 185–199. https://doi.org/10.1037/abn0000410

Zhang, X., Wu, Y., & Liu, S. (2019). Exploring short-form video application addiction: Socio-technical and attachment perspectives. *Telematics and Informatics*, *42*, 101243. https://doi.org/10.1016/j.tele.2019.101243

GROWTH AND YIELD PERFORMANCE OF SWEET POTATO 'IMELDA' CULTIVAR ON DIFFERENT TYPES OF COCONUT-BASED BIOCHAR AS SOIL CONDITIONER

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ABSTRACT

The study explored the result of the utilization of biochar derived from coconut husk, young coconut, and coconut pulp on the growth and yield response on sweet potato (*Ipomoea batatas*). The study is conducted in Occidental Mindoro, where coconut husk and pulp are often treated as waste. The main objectives are to evaluate how these biochars function as soil conditioners, influencing growth metrics such as vine length, leaf count, and fresh biomass, alongside yield factors including the number, length, diameter, and weight of marketable tuberous roots. The research also assessed changes in soil properties, specifically water-holding capacity and bulk density. Employing a randomized complete block design, the study had five treatments: the control (no application of biochar) and four types of biochar (T1-Coconut husk, T2-Young Coconut, T3-Coconut Pulp, T4-carbonized Rice Hull), with 3 sample plants per plot. Carbonization of the coconut substrates was conducted using a steel drum kiln, adhering to established protocols. Sweet potato cuttings with the cut distance 30cm from the tip were planted using a furrow method, ensuring proper spacing and replanting of missing hills. Results showed comparable effects in growth and yield parameters with biochar applications compared to the control, with young coconut biochar resulting in the highest leaf count (mean = 457) and coconut pulp biochar yielding the best overall performance in yield metrics. While all biochar treatments outperformed the control, no significant differences were observed among the biochars, except in tuber diameter. Additionally, application of coconut-based biochar enhanced soil characteristics through increasing water holding capacity and reducing bulk density. In conclusion, coconut-based biochar is an effective soil amendment for sweet potato cultivation, particularly the use of coconut pulp biochar for optimal yield. As this study highlights the potential of using agricultural waste to enhance crop productivity and improve soil quality in resource-limited settings, further study must be conducted with the focus on the proper amount of its application as well as field trials

Keywords: *biochar, cocos, Ipomoea batatas, oryza, soil*

SDG: *SDG 2: Zero Hunger, SDG 15: Life on Land*

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INTRODUCTION

Scientifically known as Ipomoea batatas L., sweet potatoes are often called the crop of the poor. This nutritious food is typically eaten as a staple and vegetable. With a global yield of around 131 million tons, sweet potatoes (Ipomoea batatas) rank seventh among the world's most produced food crops. They are the third most produced root crop, with nearly 300 million tons produced annually, following potatoes, which are ranked fourth among food crops (Loebenstein, 2016). In the Philippines, sweet potatoes are locally referred to as "camote." According to data from the PCAARD, Eastern Visayas is the leading sweet potato producer, contributing 98.95 thousand MT, or 18.8% of the total production in 2019.

According to the Office of the Provincial Agriculturist as of 2024, concerning Occidental Mindoro, the average production of sweet potatoes is 109.65 metric tons. However, as per the 2018 data, the total sweet potato production was 14, 726, 165 metric tons. Particularly, Occidental Mindoro contributed 0.09% to this total, amounting to approximately 14,686 metric tons. Notably, San Jose exhibits the highest production, totaling approximately 325.9 MT as of 2023. The Municipality of Calintaan leads a contribution of about 25 metric tons. The mean output of sweet potatoes in Occidental Mindoro is 8.80 hectares, with San Jose being the primary contributor as well to the overall sweet potato yield.

Sweet potatoes exhibit sensitivity to different soil conditions, with their growth and yield outcomes directly influenced by the soil they occupy. Achieving high yield requires addressing the specific compatibility requirements of sweet potato plants, especially in 1 case where there may be lower nutrient demand. Understanding and effectively managing the soil conditions is essential for optimizing the growth and productivity of sweet potato crops.

Sweet potatoes encounter issues related to soil compatibility, which affect their growth and production. In root crop cultivation, especially sweet potatoes, various soil problems can arise, such as soil compaction caused by excessive water or poor drainage. However, the impact of different soil amendments on improving the growth and yield of enhanced sweet potato varieties remains uncertain (Darko, 2020). Additionally, coconut-based waste presents its own set of problems. Waste generated from coconut processing harms soil fertility and creates environmental concerns. By-products from the coconut industry, such as coconut wood pieces, shells, coir, coconut water, outer shells, and fibers, are non-consumable and contribute to negative environmental effects.

The issue of coconut waste is becoming more complex as it accumulates in markets and areas where coconuts are processed. Since coconut waste is organic and decomposes easily, it can lead to environmental problems like greenhouse gas emissions. Over time, this waste accumulates as a residual product in the environment (Dumasari et al., 2020).

The abundant availability of coconut material residues such as the coconut husk, young coconut, and coconut pulp has great potential for biochar as soil conditioner for the root crops specifically for the sweet potato (Ipomea batatas). It suggests that improving soil nutrients through effective amendment can positively influence overall crop productivity (Darko, 2020).

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METHODS

Research Design

The study employed the experimental method of research utilizing Randomized Complete Block Design (RCBD). Each experimental block was 0.75 meter in length and 1.5 meters in width, and the planting distance was 30 cm x 75 cm. The plant distance was based on the recommended 44,000 plant density for sweet potato per hectare. Each experimental unit accommodated 5 sweet potato cuttings.

Collection of Rice husk

The different coconut-based substrates were collected at San Jose and Mamburao Occidental Mindoro areas with coconut plantations. Various types of coconut waste were sourced from different locations. Young coconuts were primarily obtained from the wet market in San Jose, Occidental Mindoro, where the pulp was also available for purchase. However, the carbonized rice hull was taken from the Occidental Mindoro State College-Murtha Campus (Upper) because it was readily available.

Drying of Substrates

The different types of coconut-based substrates were sun-dried. The coconut pulp was sun-dried for 2-3 days, while the young coconut was dried for 3-5 days. However, the coconut husk was not sun-dried since it was already dried and ready for carbonization. However, the carbonized rice hull did not have to go through the carbonization process because it was already carbonized when it was taken.

Carbonization of Substrates

The coconut substrate was carbonized using a steel drum as a carbonizing kiln (Ridwan et al., 2017). The drum had three sets of six 1-inch diameter holes at the bottom, middle, and upper layers, along with a lid. Each substrate, coconut husk, young coconut, and coconut pulp were placed in separate drums. A four-inch diameter wooden pole was temporarily placed in the center of each drum to create a hollow space for smoke flow during carbonization. After 5-10 minutes, when the fire was established, the lid was placed, and the upper and middle sets of holes were closed. Stirring occurred every 5 minutes throughout the process. The substrate was considered carbonized when it changed color, lost weight, became smoother or more brittle, and increased in hardness. After 2 hours, the drum was opened, and the cooling process lasted for 8 hours.

Land Preparation

The area measured about 9.75 m x 9.5 m with a total area of 92.63 m². The field was deeply plowed using four-wheel with disc plow and harrowed twice using a four-wheel tractor with rotavator. Spade was used to create a ridge (plot) with a height of 0.25 meters. Large soil chunks were crushed, ensuring a smooth texture. The cultivated plot measured 1.5 m x 0.75 m, with three blocks having a 1-meter distance per plot.

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Application of Various Soil Conditioners

Biochar weighing 1.875 kg was introduced or mixed into the soil per plot based on the recommended ratio of 15T/h, equivalent to 15,000 kg per hectare, and a total of 5.625 kg per treatment (Hayashi, 2013). The different types of coconut-based biochar mixed into the soil before planting the sweet potato cuttings.

Selection and Preparation of Planting Material

The desired sweet potato cutting had at least 6 nodes. The cuttings were cut horizontally at 30 cm from the tip. The leaves were eliminated from the part of the cuttings that was to be planted. The prepared cuttings were planted immediately.

Planting of Cuttings

The cuttings were planted using the furrow method and were placed vertically. Three nodes of the cutting were buried in the letter 'L' planting position with 30 cm spacing between hills or between cuttings. After 2 weeks of planting, the missing hills were checked, and replanting was considered to ensure a responsible and effective crop management strategy.

Fertilizer Application

A 45 g of fertilizer per experimental unit of inorganic fertilizer NPK with a grade of 14-14-14 was applied 4 weeks after planting. The last application was made for the next 4 weeks after the first application.

Water Management

The newly planted sweet potatoes were irrigated regularly from the time of planting until 77 DAT, as this period coincided with the El Niño season, which experienced temperatures reaching 43°C on the first day of planting. In contrast, due to heavy rainfall weather conditions that followed, the sweet potatoes received minimal irrigation between the months of June to August during its reproductive stage.

Pest Management

The increased temperatures resulted in a significant presence of various pests. Sweet potatoes were strategically planted along the perimeter fences to deter rodents and enhance crop safety. Rodenticide was applied twice, while pesticide targeting hornworms was similarly applied twice. Furthermore, fences were constructed around the experimental field, supplemented with netting for added protection.

Weeding

After planting for two weeks, agricultural methods were used to eliminate weeds through manual hand weeding. Weeds were immediately removed each time they sprouted in the experimental field.

Harvesting and Post-Harvest Handling

Due to the changing weather conditions, the flowering of sweet potato was delayed, and the timing of harvest was affected. The harvesting of sweet potatoes was conducted 154

days after planting. To avoid injuring tubers, the primary crown of the plant was identified, and a digging pork was used to get underneath the sweet potatoes and loosen up the soil. The harvested tubers were cleaned by removing dirt using water before data gathering.

Data Gathering Procedure

The total Number of Leaves per plant was determined by counting the leaves of the three sample plants three times. The first count was done within 28 days after planting; the next count was done after another 28 days, and the last counting was done after harvesting. The counted leaves were marked using a pentel pen marker to be excluded in the next count. Manual counting was used to record all leaves of the three sample plants. The Length of Vines was obtained from the longest lateral vine of each sample plant. The representative lateral vine was measured from the base to the tip of vines using a meter stick and was expressed in centimeters. The data was measured after harvesting. The Fresh Biomass was determined by measuring the fresh total weight of the plant material of sweet potato including leaves and vines, after it was freshly harvested. This was measured using a digital weighing scale. The Weight of Tuberous Root was determined by measuring the weight of three tuberous roots per plot in grams after harvesting, utilizing a digital weighing scale. The Diameter of Tuberous Root was determined by measuring the diameter of the tuberous roots from a randomly selected sample plant. Measurements were in centimeters, using a digital vernier caliper. The Length of Tuberous Root was determined by measuring all the tuberous roots per plant after harvesting and was expressed in centimeters using a ruler. For Water Holding Capacity, the soil was collected before and after the experiment following the drip loss technique. The result was categorized and interpreted according to the water-holding capacity scale: low (>29%), moderate (30 to 59%), and high (60 to 100%). Bulk Density is the measure of the density of a porous material that makes the density of the soil material (ps) and the amount of porosity. The general scale of bulk density (g/cm3) was interpreted based on the scale by Hazelton and Murphy (2007). Soil pH was measured using a four-in-on soil instrument before and after the application of different types of coconut-based biochar. Before the application of coconut-based biochar, soil pH was taken in different parts of the area even before the experimental plot was built.

Table 1. Water-holding capacity scale

WATER-HOLDING CAPACITY	RATINGS
>29%	Low
30-59%	Moderate
60-100%	High

Data Processing and Analysis

The F-test or Analysis of Variance (ANOVA) for RCBD was used in the analysis of data. Data processing and analysis were done using Statistical Techniques for Agricultural Research (STAR), which was developed by the International Rice Research Institute (IRRI).

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RESULT

The influence of different coconut-based biochar types such as soil conditioners on the growth of sweet potato.

The number of sweet potato leaves influenced by different types of coconut-based biochar as a soil conditioner was determined. According to the Tukey Honestly Significant Difference (HSD) results, the effects of Treatment 0, Treatment 1, Treatment 3, and Treatment 4 were statistically comparable to each other. On the other hand, Treatment 2 with a mean of 457 is significantly different from the rest of the treatments.

Data shows that Treatment 1, which is the Coconut husk, obtained a mean of 250.33 cm. On the other hand, sweet potato from T0, without soil conditioner obtained the lowest mean of 192.22 cm.

Treatment 4 in the fresh biomass, which is the carbonized rice hull produced the highest mean of 789 g. Subsequently, Treatment 1 with 759.72 g mean, Treatment 2 with 757 g mean, and Treatment 3 with 713 g. On the other hand, sweet potatoes from T0, without soil conditioner obtained the lowest mean of 709 g

Table 2. The influence of different coconut-based biochar types such as soil conditioner on the growth of sweet potato.

Treatment	Number of Leaves	Length of Vines	Fresh Biomass
T^0 - Soil	226.44	192.22	708.61
T^1 - Coconut Husk	259.56	250.33	759.72
T^2 - Young Coconut	456.89	206.78	756.67
T^3 - Coconut Pulp	191.33	218.11	712.78
T^4 - Carbonized Rice Hull	249	231.55	789.17
F-value	22.88	0.49^{ns}	0.09^{ns}
p-value	0.002*	0.74	0.98
Grand mean	276.64	219.80	745.39

The effect of various coconut-based biochar as soil conditioner on the yield of sweet potato

Data shows that Treatment 3 recorded the highest weight of tuberous roots with a mean of 239 g. On the other hand, Treatment 1 obtained the lowest mean of 111.3 g. Meanwhile, like treatment 3, treatment 2 and treatment 4 are higher than Treatment 0. The average weight of tuberous sweet potatoes ranges from 142 to 198 grams. In comparison, treatment 3 exceeded this average weight. However, treatments 0, 1, 2, and 4 fell below the average weight of sweet potatoes

Table 3. The effect of various coconut-based biochar as soil conditioner on the yield of sweet potato.

Treatment	Weight of Tuberous Roots (g)	Diameter of Tuberous Roots (cm)	Length of Tuberous Roots (cm)
T^0 - Soil	128	35.36	93.33
T^1 - Coconut Husk	111	24.84	106.67
T^2 - Young Coconut	144	29.50	112.33
T^3 - Coconut Pulp	239	39.18	126.33
T^4 - Carbonized Rice Hull	132	25.68	117
F-value	1.99^{ns}	1.36^{ns}	2.22^{ns}
p-value	0.19	0.33	0.16
Grand mean	150.93	30.91	111.13

The diameter of tuberous roots of sweet potato is affected by the different types of coconut-based biochar as soil conditioner. Treatment 3 gathered a highest mean of 39.18 cm. Treatment 1, on the other hand, obtained the lowest mean of 24.84 cm.

Treatment 3 from the length of tuberous roots registered the highest mean of 126.33 cm. On the other hand, sweet potato from T0, without soil conditioner obtained the lowest mean of 93.33 cm.

The influence of coconut-based biochar as soil conditioner on the soil properties of sweet potato

Data shows the water holding capacity of the soil. According to the result, prior to intervention, all soil treatments exhibited a high-water holding capacity of 86%. This finding indicates that both the original soil and the amendments utilized could retain a significant amount of moisture. Subsequently, a significant difference in all treatments was observed. The most notable reduction occurred in Treatment 2 (young coconut), which decreased to 59% categorized as "Moderate" water holding capacity. However, the remaining treatments, Treatment 1, Treatment 3, and Treatment 4, experienced more moderate declines, with their water holding capabilities reducing to 62%, and 61%, respectively.

According to the results, Treatment 1 recorded the highest bulk density at 0.10g/cm3, which is classified as "Very low". Similarly, Treatment 2, with a bulk density 0.07g/cm3, is also categorized as "Very low", despite having a slightly lower value. After application, the Treatment 0, which is registered 0.9g/ cm3 interpreted as "Very low". Similarly, the Treatment 1, 2, 3, and 4 which posted 0.08 g/cm3 is also categorized as "Very low', despite exhibiting a marginally reduced value.

Based on the result on the soil pH, all treatments have a similar effect to the soil which interpreted 4.5 interpreted as "Strongly acid". However, following the application of coconut-based biochar, there were significant differences observed compared to the pre-condition. There is an increase in pH in the soil treated with different types of coconut-based biochar. Young coconut treatment (T2) registered 5.5 interpreted as "Strongly acid". Likewise, the Treatment 1 which is coconut husk and coconut pulp have a similar effect registered 5.4 as

"Strongly acid". Nevertheless, Treatment 4 and 0 are comparable with the pH level 4.5 and 5.0 interpreted as "Very strongly acid".

Table 4. The influence of coconut-based biochar as soil conditioner on the soil properties of sweet potato

Treatment	Water Holding Capacity				Bulk Density				Soil pH			
	Pre	Int.	Post	Int.	Pre	Int.	Post	Int.	Pre	Int.	Post	Int.
T^0-Soil	86%	H	62%	H	0.09	VL	0.09	VL	4.5	SA	4.5	SA
T^1-Coconut Husk	86%	H	62%	H	0.09	VL	0.08	VL	4.5	SA	5.4	MA
T^2-Young Coconut	86%	H	59%	M	0.09	VL	0.08	VL	4.5	SA	5.5	SA
T^3 - Coconut Pulp	86%	H	61%	H	0.09	VL	0.08	VL	4.5	SA	5.1	MA
T^4-Carbonized Rice Hull	86%	H	61%	H	0.09	VL	0.08	VL	4.5	SA	5.0	SA
Mean	86%	H	61%	H	0.09	VL	0.08	VL	4.5	SA	5.1	SA

Legend: Water Holding Capacity: L-Low; M-Moderate; H-High
Bulk Density: VL-Very Low; L-Low; M-Moderate; H-High;
Soil pH: VSA-Very strongly alkaline; SAL-Strongly alkaline; MAL-Moderately alkaline; MIA-Mildly alkaline: N-Neutral; SA-Slightly acidic; MA-Moderately acidic; SA-Strongly acidic

DISCUSSION

Number of Leaves

Young coconut waste as a soil conditioner significantly boosts sweet potato leaf production. Biochar made from coconuts improves soil's chemical and physical properties, enhancing fertility and promoting healthier plant growth. It improves leaf quantity and quality (Sanchez-Reinoso et al., 2020) and reduces stress, leading to stronger leaves (Hasnain et al., 2022). Biochar application (1.5%) increases total nitrogen, essential for leaf growth (Herviyanti et al., 2020). It also enhances soil properties by increasing pH, organic matter, nitrogen, phosphorus, potassium, calcium, and magnesium, thereby creating an optimal environment for nutrient uptake and plant growth, which leads to more leaves (Maulana et al., 2023).

Vine Length

There was no significant difference in vine length between sweet potatoes with and without coconut-based biochar. Treatment 1 (coconut husk) had the highest mean, while T0 (no biochar) had the lowest. Edussuriya et al. (2023) found biochar increases vine length and leaf number, but environmental factors affect vine length. Gajanayake (2015) noted that high temperatures lead to more vine and leaf growth, but fewer tubers and lower yields. Nazrul (2018) reported sweet potato vine lengths ranging from 165.33 to 230.27 cm at 120 days. The study showed average vine lengths like or exceeding standard values, but no significant difference compared to the control without biochar.

Fresh Biomass

Fresh biomass determines if coconut-based biochar affects vine and leaf growth. No significant difference was observed in fresh biomass, but plants grown without biochar had greater weight than the control. The type of coconut-based biochar used influenced vegetative growth and fresh biomass. High temperatures during the experiment may have affected growth, as heat stress impacts plant development. Gajanayake et al. (2015) noted that high temperatures during mid- to late-growing seasons cause plants to prioritize leaf and vine growth over root development, resulting in fewer tubers and lower yields. Motsa et al. (2015) explained that slower canopy growth limits energy for root development. Our leaf count data showed an increase in leaves during the second count, but despite soil cracking, no maturity indicators were found after inspection and tilling, including in the buffer zone.

Weight of Tuberous Roots

There was no significant difference in the weight of tuberous roots between sweet potatoes with and without coconut-based biochar. Treatment 3 had the highest weight, while Treatment 1 was the lowest. The yield decrease was observed due to factors like drought stress and unpredictable weather. On March 26, 2024, temperatures in San Jose, Occidental Mindoro reached 43°C, signaling the start of El Niño and the planting of sweet potato cuttings. By May, temperatures rose to 44°C (PAGASA, 2024). While sweet potatoes are drought-tolerant after tuber formation, inconsistent rainfall can still reduce yields (Andrade et al., 2016). Photoperiodism, a tropical characteristic, also limits growth to early-ripening varieties during extended growing periods (Pepo, 2018). Drought stress negatively affects storage, root weight, biomass, and root number (Kivuva et al., 2014; Saqib et al., 2017). As seen in fresh biomass, plants focus more on leaf and vine growth. Excessive vegetative growth can reduce tuber yields as plants prioritize leaves and stems over tuber development. A balanced vegetative and reproductive phase enhances tuber production (Widaryanto & Saitama, 2017).

Diameter of Tuberous Roots

There was no significant difference in the diameter of sweet potato tuberous roots between those treated with coconut-based biochar and those without. Treatment 3 had the highest mean diameter, while Treatment 1 had the lowest. According to the Bureau of Agriculture and Fisheries Standards (2010), medium-sized sweet potatoes have a diameter of 51 to 70 mm. Treatment 3, with a diameter of 39.19 mm, falls under the small category. While all treatments produced tubers with below-average diameters, small tubers are still commercially viable. Weather conditions, such as temperature and soil moisture, influenced tuber formation and diameter. High temperatures exceeding 35°C (43-44°C from March to June 2024, PAGASA, 2024) caused heat stress, reducing tuber size and quality.

Length of Tuberous Roots

There was no significant difference in the length of tuberous roots between sweet potatoes with and without coconut-based biochar. Treatment 3 had the highest mean, while T0 (without biochar) had the lowest. After harvest, more pencil roots were observed than tuberous roots. Pencil roots as lignified, smaller roots, while tuberous roots are fleshy and bulky. Pencil roots typically form in low rainfall environments, especially under stress conditions like water

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deficit and high temperatures, where some lateral roots become pencil roots (Goldman et al., 2023).

Water Holding Capacity

All soil treatments showed a high water-holding capacity of 86%, indicating effective moisture retention by both the original soil and the amendments. A significant difference was observed across all treatments. Coconut biochar improves water holding capacity as a soil amendment by enhancing structural aggregation and promoting beneficial microbial activity, which supports biological processes and increases nutrient availability (Nepal et al., 2023). Experimental results showed that higher biochar concentrations improved water retention in the upper 300 mm of soil and enhanced pH. Coconut biochar also significantly increases nutrient retention, especially in sandy soils (Guarnieri et al., 2021).

Bulk Density

The application of coconut biochar lowers bulk density, which increases soil porosity. Pandian et al. (2016) demonstrated that applying biochar at a rate of 5 t ha^{-1} decreased the bulk density of medium-textured soil from 1.41 to 1.36 Mg m^{-3}. This reduction improves soil structure by increasing pore space, allowing better air and water movement, and ultimately enhancing soil health and plant growth (Pituya, 2017). A study on sandy loam soil showed a reduction in bulk density from 1.41 g/cm^3 to 1.38 g/cm^3, while the current study showed a decrease from 1.56 g/cm^3 to 1.27 g/cm^3 (Boadu et al., 2024).

Soil Ph

Coconut biochar improves soil pH due to its liming effect, neutralizing acidic soils and creating a favorable environment for plant growth. Sweet potatoes tolerate pH levels from 5.5 to 6.8, but the optimal range for maximizing yield and high-quality tubers is 5.8 to 6.0. Biochar, combined with organic matter, enhances soil properties by providing essential carbon and nutrients, improving both physical and chemical characteristics (Herlambang et al., 2019). Soil pH of 6.5 is optimal for nutrient availability. Low pH increases the solubility of aluminum, manganese, and iron, potentially reaching toxic levels, while extreme pH values affect nutrient access and microbial activity (Cornell University, n.d.) Additionally, the alkalinity of biochar helps neutralize acidic soils, boosting fertility and promoting plant growth (Dhar et al., 2020).

CONCLUSION

The use of various coconut-based biochar's had similar impacts on vine length and fresh biomass of sweet potato, but biochar made from young coconut significantly boosted leaf production. When it came to yield, all biochar types performed similarly, although coconut pulp biochar led to superior outcomes in all yield parameters. Despite no notable differences among the biochar treatments in terms of growth and yield, all of them outperformed the control group—except in the case of tuberous root diameter. Moreover, coconut-based biochar improved soil characteristics by enhancing water retention, lowering bulk density, and balancing soil pH.

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REFERENCES

Andrade, M.I., Naico, A., & Ricardo, J. (2016). Genotype × environment interaction and selection for drought adaptation in sweetpotato (Ipomoea batatas [L.] Lam.) in Mozambique. Euphytica 209, 261–280 (2016). https://doi.org/10.1007/s10681-016-1684-4

Boadu, K. B., Soadwa, C. O., Adamu, O., Ansong, M., Kaba, J. S., & Anokye, R. (2024). The Impact of Varying Biochar Rate and Particle Size Derived from Bamboo Culm Residue and Coconut Husk Mixture on Lettuce (Lactuca sativa cv. 'Tiberius') Seed Germination and Leaf Morphology. Journal of Sustainability Research. https://doi.org/10.20900/jsr.20160001

Cornell Univeristy. (n.d). Competency area 5: Soil pH and liming. Northeast Region Certified Crop Adviser (NRCCA) Study Resources. https://nrcca.cals.cornell.edu/nutrient/CA5/CA0539.php

Darko, C., Yeboah, S., Amoah, A. A., Opoku, A. R., & Berchie, J.N. (2020). Productivity of sweet potato (Ipomoea batatas (L) Lam) as influenced by fertilizer application in different agro-ecologies in Ghana. Scientific African. https://doi.org/10.1016/j.sciaf.2020.e00560

Dhar, S. A., Sakib, T. U., & Hilary, L. N. (2020). Effects of pyrolysis temperature on production and physicochemical characterization of biochar derived from coconut fiber biomass through slow pyrolysis process. Biomass Conversion and Biorefinery, 12(7), 2631–2647. https://doi.org/10.1007/s13399-020-01116-y

Dumasari, D., Darmawan, W., Iqbal, A., Dharmawan, B., & Santosa, I. (2020). A pro conservation adaptation power model for cococraft craftsmen using coconut waste in Purbalingga, Central Java, Indonesia. International journal of conservation science, 11(1). *11*(1), 87–96.

Edussuriya, R., Rajapaksha, A. U., Jayasinghe, C., Pathirana, C., & Vithanage, M. (2023). Influence of biochar on growth performances, yield of root and tuber crops and controlling plant-parasitic nematodes. https://link.springer.com/article/10.1007/s42773-023-00261-7

Gajanayake, B., Reddy, K. R., Shankle, M.Y., & Arancibia, A.R. (2015). Quantifying Storage Root Initiation, Growth, and Developmental Responses of Sweetpotato to Early Season Temperature. Agronomy Journal. https://doi.org/10.2134/agronj14.0067

Goldman, I. L., Wang, Y., Alfaro, A. V., Brainard, S., Oravec, M. W., McGregor, C. E., & van der Knaap, E. (2023). Form and contour: breeding and genetics of organ shape from wild relatives

to modern vegetable crops. Frontiers in plant science, 14, 1257707. https://doi.org/10.3389/fpls.2023.1257707

Guarnieri, S. F., Nascimento, E. C. D., Costa, R. F., Faria, J. L. B. D., & Lobo, F. D. A. (2021). Coconut fiber biochar alters physical and chemical properties in sandy soils. Acta Scientiarum. Agronomy, 43, e51801. https://doi.org/10.4025/actasciagron.v43i1.51801

Hazelton, P. & Murphy, B. (2007). Interpreting Soil Test Results What do all the Numbers Mean? University of Technology Sydney. NSW Government Department of Natural Resources. https://doi.org/10.1071/9781486303977

Hasnain, M., Munir, N., Abideen, Z., Zulfiqar, F., Koyro, H. W., El-Naggar, A., Caçador, I., Duarte, B., Rinklebe, J., & Yong, J.W.H. (2022). Biochar-plant interaction and detoxification strategies under abiotic stresses for achieving agricultural resilience: A critical review. Ecotoxicology and Environmental Safety, 249, 114408. https://doi.org/10.1016/j.ecoenv.2022.114408

Hayashi, K., Gummert, M., & Zaini, Z. (2013). Biochar for future food security: learning from experiences and identifying research priorities. In National Workshop on 53 Biochar for Food Security: Learning from Experiences and Identifying (pp. 37-46). https://doi.org/10.1016/J.RESCONREC.2021.106109

Herlambang, S., B., Sutiono, H. T., & Susantina, R.N. (2019). Application of coconut biochar and organic materials to improve soil environment. IOP Conference Series Earth and Environmental https://doi.org/10.1088/1755-1315/347/1/012055

Herviyanti, H., Maulana, A., Prima, S., Aprisal, A., Crisna, S. D., & Lita, A. L. (2020). Effect of biochar from young coconut waste to improve chemical properties of ultisols and growth coffee [Coffea arabica L.] plant seeds. IOP Conference Series Earth and Environmental Science, 497(1), 012038. https://doi.org/10.1088/1755 1315/497/1/012038

Kivuva, B.M., Githiri, S. M., Yencho, G.C., & Sibiya, J. (2014). Screening sweet potato genotypes for tolerance to drought stress. Field Crops Research, 171, 11–22. https://doi.org/10.1016/j.fcr.2014.10.018

Loebenstein, G. (2016). Sweet Potato, research Neglected important food crop, Regarding Virus research and Propagation systems: A review. Austin J Plant Biol. 2016; 2(1): 1012. https://doi.org/ 10.18517/ijaseit.9.2.7520

Maulana, A., Sukma, V., Napendra, Z., Harianti, M., Prasetyo, T. B., & Herviyanti, H. (2023). Application of biochar from young coconut waste to inactivation of Hg contaminated ex-gold mining soil and corn (Zea mays L.) vegetative growth. AIP Conference Proceedings, 2730, 120007. https://doi.org/10.1063/5.0127760

Motsa, N. M., Modi, A. T., & Mabhaudhi, T. (2015). Sweet potato (Ipomoea batatas L.) as a drought tolerant and food security crop. South African Journal of Science, 111(11/12), 8. https://doi.org/10.17159/sajs.2015/20140252

Nazrul, M. I. (2018). On-farm evaluation of orange fleshed sweet potato varieties under acidic soil of north-east region in Bangladesh. Bangladesh Agronomy Journal, 21(2), 59-65. https://doi.org/10.3329/baj.v21i2.44493

Nepal, J., Ahmad, W., Munsif, F., Khan, A., & Zhou, Z. (2023). Advances and prospects of biochar in improving soil fertility, biochemical quality, and environmental applications. Frontiers in Environmental https://doi.org/10.3389/fenvs.2023.1114752

Pandian, K., Subramaniayan, P., Gnasekaran, P., & Chitraputhirapillai, S. (2016). Effect of biochar amendment on soil physical, chemical and biological properties and groundnut yield in rainfed Alfisol of semi-arid tropics. Archives of Agronomy and Soil Science, 62(9), 1293-1310. https://doi.org/10.1080/03650340.2016.1139086

Pepo P. (2018). The effect of different planting methods on the yield and spad readings of sweet potato (Ipomoea batatas L.) Columella - Journal of Agricultural and Environmental Sciences Vol. https://doi.org/10.18380/SZIE.COLUM.2018.5.1.7

Pituya, P., Sriburi, T., & Wijitkosum, S. (2017). Properties of Biochar Prepared from Acacia Wood and Coconut Shell for Soil Amendments. Engineering Journal. https://doi.org /10.4186/ej.2017.21.3.63

Ridwan, L. W. (2025, May). Coconut Shell Carbonization to Produce Biochar Using a Cylinder Retort Kiln. In Proceedings of the 8th FIRST 2024 International Conference on Global Innovations (FIRST-ESCSI 2024) (Vol. 261, p. 245). Springer Nature. 10.2991/978-94-6463-678-9_23

Sanchez-Reinoso, A. D., Ávila-Pedraza, E. A., & Restrepo, H. (2020). Use of Biochar in agriculture. Acta Biológica https://doi.org/10.15446/abc.v25n2.79466

Saqib, M., Khalid, M., Hussain, S., & Anjum, M. A. (2017). Effect of water stress and planting system on growth, yield and quality of sweet potato. Acta Scientiarum Polonorum. Hortorum Cultus, https://doi.org/10.24326/asphc.2017.6.18

Widaryanto, E., & Saitama, A. (2017). Research Article Analysis of Plant Growth of Ten Varieties of Sweet Potato (Ipomoea batatas L.) Cultivated in Rainy Season. Asian J. Plant Sci, 16, 193-199. https://doi.org/10.3923/ajps.2017.193.199

EVALUATING THE EFFICACY OF EDIBLE COATING WITH GINGER AND SEAWEED EXTRACT AS BLACK MOLD INHIBITOR FOR PROLONGING ONION RED DRAGON CULTIVAR SHELF LIFE

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ABSTRACT

This study evaluated the efficacy of an edible coating made from ginger and seaweed extract as a black mold (*Aspergillus niger*) inhibitor to prolong the shelf life of 'Red Dragon' onions. The experiment was conducted from April to August 2024 at the OMSC Food Processing Center and Crop Protection Laboratory, Murtha Campus, San Jose, Occidental Mindoro. A Complete Randomized Design (CRD) was employed, testing four treatments on 250-gram samples of onions exposed to *Aspergillus niger*, replicated three times. The treatments included a control (T0: no treatment) and varying concentrations of seaweed extract (SE) and ginger extract: T1 (100mL SE + 15mL ginger extract), T2 (100mL SE + 20mL ginger extract), T3 (100mL SE + 25mL ginger extract), and T4 (100mL SE + 30mL ginger extract) per 250 grams of onion. The study assessed weight loss percentage, total soluble solids, rotten bulb percentage, and sprouted bulb percentage. Results indicated that the edible coatings managed weight loss and total soluble solids effectively, and all treatments completely inhibited rotting during the study period. Sprouting was minimal, with only the highest ginger extract concentration (T4) showing a slight percentage of sprouted bulbs. The findings suggest that ginger and seaweed extract edible coatings show promise as a natural method for preserving onions, inhibiting black mold, and extending shelf life. Further research is recommended to optimize extract concentrations and assess long-term storage effects.

Keywords: *Black mold inhibitor, Edible coating, Onion, Post harvest technology*

SDG*: SDG 2: Zero Hunger, SDG 12: Responsible Consumption and Production*

INTRODUCTION

Onions (*Allium cepa*), particularly the Red Dragon F1 variety, are economically significant herbaceous crops belonging to the lily family, widely cultivated for their distinctive flavor and versatility in global cuisines (Ioku et al., 2001). Often paired with garlic, onions are a staple in Southeast Asian cooking, including the Philippines, where the demand for onion monthly averages around 17,000 metric tons. The Philippines has seen significant growth in onion production; in the second quarter of 2022, output increased by 20.2% to reach 82.08 thousand metric tons, up from 68.27 metric tons the previous year (Department of Agriculture, 2025). This increase reflects the recognition by Filipino farmers, including those in Occidental Mindoro, of onions as a profitable cash crop, with potential profits per hectare exceeding those of five hectares of rice production.

Despite the economic potential, postharvest losses remain a significant impediment due to the perishable nature of onions and inadequate storage infrastructure. In 2022, the Department of Agriculture reported losses of 100,000 metric tons of onions due to insufficient cold storage facilities and improper handling. The limited cold storage capacity in Occidental Mindoro, accommodating only 100,000 bags or 2.8 metric tons, exacerbates this issue, contributing to a surplus in 2021 that caused onion bulb prices to plummet to ₱15-18 per kilo—below the breakeven production cost of ₱18 per kilo (Gomez, 2024).

A major contributor to postharvest losses is onion diseases, with international surveys indicating that 30-40% of stored onions are lost, and 15-20% of these losses are due to storage diseases (Kumar et al., 2015). Bulb-rotting microorganisms pose a serious threat, with *Aspergillus niger* (black mold rot) and *Penicillium spp*. Being particularly destructive fungal pathogens associated with storage diseases in onions. The incidence of these diseases is exacerbated by high temperatures and relative humidity, conditions that are common in the Philippines. Targeting mold-related problems in onion storage is therefore crucial in realizing the full economic benefits of onion production in areas like Occidental Mindoro (Liakos et al., 2024).

Exploring the promising potential of natural substances alternatives, this research undertaking explored the capability of using extracts of ginger *(Zingiber officinale)* and seaweed *(Kappaphycus alvarezii)* in the formulation of edible coatings in inhibiting toxigenic fungi (Nasim et al., 2022). Conventionally, ginger is grown in the uplands of Occidental Mindoro, which contains a considerable amount of compounds such as flavonoids, alkaloids, and tannins which are proven for their efficacy in combating various strains of Aspergillus species (Mao et al., 2019). Correspondingly, seaweed has shown and demonstrated preventive effects on fungal diseases, including *Aspergillus niger* (Chanthini, K. M., & Senthil-Nathan, S., 2024). Hence, this research study intended to assess the effectiveness of an edible coating obtained from ginger and seaweed as a mold inhibitor in prolonging the storability of Red Dragon onions, which further offers a sustainable approach to reducing a considerable amount of postharvest losses and further enhances the economic viability of onion farming in the Province of Occidental Mindoro.

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METHODS

Materials

The materials that are used during the implementation of the study and in the gathering of data to determine the efficacy of edible coating with ginger and seaweed extract as black mold inhibitors for prolonging onion 'Red dragon' cultivar shelf life [Table 1].

Table 1. Materials and their quantity and unit

Description	Quantity	Unit
Ginger	500	Grams
Seaweeds	400	Grams
Red Onion	15	Kilogram
Digital weighing scale	2	Piece
Fish Net Bags	15	Pieces
Hygrometer	1	Piece
Disposable Gloves	1	Box
Thermometer	1	Piece
Refractometer	1	Piece
Heating Magnetic Stirrer	1	Piece
Bowl	4	Piece
Juicer	1	Piece
Mortar and pestle	1	Set
Plastic Containers	15	Piece
Plastic Cover	5	Yards
Aspergillus niger Culture	1	Test tube
Inoculation chamber	1	Piece
Autoclave	1	Piece

Research Design

Completely Randomized Design (CRD) was employed in this experimental research study, where each treatment was assigned to a single variable, and all variables had an equal probability of being assigned to any given treatment. This design offered flexibility due to the limited number of treatments and replications, which were constrained by the total available units for the experiment. The treatments are as follows.

T_0 = control (no treatment)
T_1 = 100mL of SE and 15mL of Ginger Extract/250 grams of onion
T_2 = 100mL of SE and 20mL of Ginger Extract/250 grams of onion
T_3 = 100mL of SE and 25mL of Ginger Extract/250 grams of onion
T_4 = 100mL of SE and 30mL of Ginger Extract/250 grams of onion

Study Site

The study was carried out at Murtha Campus of Occidental Mindoro State College. The preparation process, including the extraction of seaweed and ginger, was conducted at

Occidental Mindoro State College Food Processing Center, and the onions were stored in the Crop Protection Laboratory.

Unit of Analysis and Sampling

Freshly harvested bulb onions were gathered from a local farmer of Sitio Naitan, Brgy. Batasan, San Jose, Occidental Mindoro on April 8, 2024. The cultivar used is the Red Dragon. This cultivar is considered because of its availability in the area. Medium-sized onion bulbs are used in the study with a diameter ranging from 35-50 mm. The size classification of onions was outlined on the size classification, set by the Philippine National Standard (2004). Ginger was bought from Pagasa, Sablayan, Occidental Mindoro and the seaweed was bought from Sta. Teresa, Magsaysay, Occidental Mindoro.

Experimental Procedures

Preparation of Seaweed Gel

Seaweed gel was prepared according to the procedure outlined by Gemida et al. (2023). Using a heating magnetic stirrer the seaweed was subjected to boiling to extract the gel. Prepared and measured five (5) grams of seaweed were placed on a beaker and simmered bringing it a boil at 100°C for about 15 minutes in 500 ml of water until the seaweed formed the solution.

Preparation Ginger Extract

The extraction of ginger was done by following the method outlined by Ibrahim et al. (2020). Prepared and measured 250g of ginger was carefully washed under potable running water, damp with a clean cloth, sliced, and blended with 500 mL distilled water for 15 minutes. A muslin cloth was used to separate the pulp from the ginger extract.

Preparation of Edible Coating

In preparing the edible coating seaweed gel was divided into four portions measuring 100mL each, it was then mixed with various amounts of extracted ginger in preparation for the four treatments. 100mL seaweed gel with 15mL ginger extract was prepared for the T1, 100mL seaweed gel with 20mL ginger extract was prepared for the T2, while 100mL seaweed gel with 25mL ginger extract was prepared and mixed and set as T3, 100mL seaweed gel with 30mL ginger extract was prepared and mixed for the T4.

Application of Edible Coating

Samples of onion bulbs were subjected to soaking for about 24 hours in various proportions and concentrations of the seaweed and ginger edible coating. Upon completion of the dipping period, the onion samples were left to air-dry for 24 hours.

Inoculation of Onion Samples with Aspergillus niger

When the onions were totally dried-up, *Aspergillus niger* was then sprayed on the onions. A fine mist sprayer was used to isolate and introduced *A. niger* culture in ensuring uniformity of distributing it. It was done following the methods outlined by Ko et al. (2002). After the inoculation process, samples were observed for a total of 7 days. To promote mold growth

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onions were placed in a controlled environment. The strain of *Aspergillus niger* procurement and validation in ensuring that a pure culture of *Aspergillus niger* is obtained and used in the conduct of the study, the researchers bought directly from the Philippine National Collection of Microorganisms (PNCM), Biotech, University of the Philippines Los Baños (UPLB), Los Baños, Laguna, Philippines. Biosecurity protocols have been observed to ensure the safety of the researchers and of the area where it has been conducted.

Data Collection Procedure

To determine the final bulb weight, TSS, and the total number of sprouted and rotten bulbs were recorded according to the storage period. Scheduled monitoring was conducted weekly, by counting sprouted and rotten bulbs that were taken at the end of the storage duration. In assessing the parameters, Weight Loss Percentage, Total Soluble Solids (TSS) changes, Bulb Rot Percentage, and Percentage of Sprouted Bulbs were taken.

The following parameters were measured with experimental setup. Weight loss relates to physiological loss of weight of the onion bulb which largely contributes to water loss (Idago et al. 2021). Percentage weight loss (%WL) was computed using the formula:

$$weight\ loss\ percentage\ = \left(\frac{Initial\ Weight\ (Day\ 0) - Final\ weight}{Initial\ Weight\ (Day\ 0)}\right) \times\ 100$$

The Total Soluble Solids (TSS) content was measured following the outlined method. A digital pocket refractometer, PAL-1 (ATAGO) model, was utilized in determining the TSS in the onion bulbs. Bulbs were chopped and then crushed using a mortar and pestle. The onion extract was placed on the refractometer prism, to determine the percentage of dry substance through a direct reading.

The bulb rot percentage was determined by the symptoms such as the softening and water-soaking of the bulb tissue, yellow to brown discoloration, and the progression of symptoms from the neck to the base of the bulb, where the neck becomes soft when pressed (Abd-Alla et al., 2017). The Bulb Rot Percentage was calculated as:

$$Weight\ of\ Rotten\ Bulbs\ at\ Day\ t\ Initial\ Weight\ of\ Onion\ Bulbs\ at\ \ (Day\ 0)^{-}\ x\ 100$$

Sprouting was defined as the emergence of leaves from the neck of the bulb (Idago et al., 2021). The Percentage of Sprouted Bulbs was calculated as:

$$Weight\ of\ Sprouted\ Bulbs\ at\ Day\ t\ Initial\ Weight\ of\ Onion\ Bulbs\ at\ \ (Day\ 0)^{-}\ x\ 100$$

Data Analysis

Data gathered in this experiment were analyzed using analysis of variance (ANOVA) in CRD at 5% and 1% levels of significance.

RESULTS

Treatment means of the parameters

Table 2 shows the summary of the different parameters of the effects of edible coatings with seaweed extract (SE) and ginger extract (GE) on various parameters of onions, Respectively, it focused on weight loss percentage, total soluble solids, rotten bulb percentage, and sprouted bulb percentage. Overall, the data indicates that the tested edible coatings had some impact on the onions.

The percentage of weight loss varies across the treatments. The control group (T0) obtained a weight loss of 3.37%. T1 and T2 showed slightly lower weight loss percentages at 3.39% and 3.27%, respectively. On the other hand, T3 and T4 exhibited higher weight loss percentages, with 4.06% and 4.11%, respectively.

The total soluble solids (TSS) also varied. The control group (T0) had a TSS of 15.63. An increased amount of ginger extract shows a decrease in total soluble solids. T4 had a TSS of 12.62, which was the lowest among all treatments.

Significantly, the percentage of rotten bulbs was 0 for all treatments, which indicates that the edible coatings, at the levels tested, effectively prevented rotting. The sprouted bulb percentage was also 0 for all treatments except T4, which had a very low percentage of 0.06667. This further suggests that higher concentrations of ginger extract might slightly promote sprouting.

Table 2. Treatment means of the parameters as affected by the edible coating with ginger and seaweed extract as a black mold inhibitor.

Treatments	Weight Loss Percentage (G)	Total Soluble Solids	Rotten Bulb Percentage (%Rb)	Sprouted Bulb Percentage
T0 = control (no treatment)	3.37	15.63	0	0
T1 = 100mL of SE and 15mL of Ginger Extract/250 grams of onion	3.39	14.56	0	0
T2 = 100mL of SE and 20mL of Ginger Extract/250 grams of onion	3.27	13.72	0	0
T3 = 100mL of SE and 25mL of Ginger Extract/250 grams of onion	4.06	12.08	0	0
T4 = 100mL of SE and 30mL of Ginger Extract/250 grams of onion	4.11	12.62	0	0.06667

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DISCUSSION

There are different factors to be considered during the storage of onion that contributed to its weight loss, these humidity, ventilation, temperature and pathogens cause by fungus. Susceptibility of onion to rotting is contributed by the loss of onion moisture and weight which primarily due to their weak structural integrity that they became more susceptible to pathogens (Isma'ila et al., 2017). The present study demonstrated that a solution made of an edible coating with the combination of seaweed and ginger extract would greatly influence the weight loss percentage, total soluble solids, and can possibly prevent rotting in onions (Sohany et al., 2016). Weed control treatments significantly decreased weight loss and maintained quality attributes during storage (Abdelgawad et al., 2025).

Moreover, the data clearly indicates the impact of edible coatings solution with the combination of seaweed extract (SE) and ginger extract on various parameters of onion preservation, including weight loss percentage, total soluble solids, rotten bulb percentage, and sprouted bulb percentage (Augusto & Pedrosa, 2014; Chavan et al., 2023). In the control group (T0), the weight loss percentage was 3.37, and the total soluble solids were 15.63, while both the rotten bulb percentage and sprouted bulb percentage were 0. Treatments T1, T2, and T3, which involved different concentrations of ginger extract combined with SE, showed variations in weight loss percentage and total soluble solids, but no rotten or sprouted bulbs. T4, with the highest concentration of ginger extract, showed a weight loss percentage of 4.11, total soluble solids of 12.62, no rotten bulbs, and a sprouted bulb percentage of 0.06667.

A study on bunching green onions found that calcium alginate edible coatings decreased weight loss during storage. Rozo et al. (2016) demonstrated that a 10% alginate edible biofilm had a favorable effect on weight loss compared to uncoated onions. Similarly, incorporating transglutaminase into edible coatings reduced weight loss in another study. The current study aligns with these findings, showing that edible coatings can help manage weight loss in onions.

Edible coatings can delay changes in the soluble solids content of fruits and vegetables. Decrease in total soluble solids with increasing ginger extract concentration. Fresh-cut Welsh onions where soluble solids content decreased after storage (Han et al., 2016). Higher TSS levels are associated with enhanced storability and reduced decay during storage, as they contribute to a greater percentage of dry matter, which in turn extends bulb storage life (Mallor, 2008, as cited in Chávez-Mendoza et al., 2016).

The rotten bulb percentage was assessed based on specific symptoms, such as tissue softening, water-soaking, yellow to brown discoloration, and the spread of these symptoms from the neck to the base, with the neck becoming soft when pressure is applied (Nisa et al., 2024). *Aspergillus niger* mostly infects onion bulbs during the postharvest phase, it is indicated by black spores on the outer scales of onion, and it can lead to rot through secondary bacterial infections (Anadani, R.S.V., & Vanthana, L.a.M., 2017).

A bulb was considered as sprouted when leaves emerged from the neck. And the percentage of sprouted bulbs is calculated by taking and recording the weight of the sprouted bulbs on a specific day, after which it is being divided by the initial weight of the bulbs from day

0, and then multiplying the result by 100 (Idago et al., 2021). In addition, high humidity levels would encourage sprouting, while inadequate ventilation can lead to humidity pockets within the onion piles (Hatem et al., 2014). In contrast, lower humidity levels in well-ventilated storage areas tend to decrease sprouting rates (Hankar et al., 2017). Another contributory factors which affect the dormancy period and subsequent sprouting of onion bulbs is its genetic variation. Distinctively, each onion cultivars may exhibit unique dormancy patterns shaped by their genetic characteristics. Certain genotypes are more susceptible to early sprouting due to lower levels of ABA or changes in hormonal responses during dormancy (Puccio et al., 2022). In this study, only one onion bulb sprouted, which may be attributed to the genetic differences present in that particular bulb.

Recent investigations suggests that through proper post-harvest handling, curing and storage method, sprouting and rotting can be prevented and even lessened. compared to non-cured bulbs which shows a significant sprouting and rotting after eight weeks upon storing. Results of the study revealed that the treatments effectively inhibited rotting, which further aligns with the common understanding that proper postharvest treatments can reduce such issues.

Moreover, findings reveal the potential to develop effective, natural edible coatings to extend the shelf life while maintaining the quality of onions. Utilizing seaweed and ginger extracts could offer a promising substitute to chemically produce preservatives, which aligns with the consumer preferences for a natural food preservation method. Furthermore, the study contributes to Sustainable Development Goal (SDG) target 12.3, which aims to reduce food losses along the production and supply chains.

The study's limitation could be the lack of detailed analysis and test of the primary and specific compounds present in ginger and seaweed extracts which are responsible for the observed effects on the study conducted. In addition, the study could benefit from a longer storage period to fully determine and assess the long-term effectivity of the developed coatings. Further research could also be explored primarily on the organoleptic attributes of the coated onions to ensure the acceptability of the consumers.

Researchers could also consider enhancing the inhibitory properties of the edible coatings by adding other natural compounds or by utilizing and infusing essential oils. Research reports indicated that components from spices like cinnamon, clove, and pepper could have an inhibitory action against black mold. In Addition, further research on the optimization of the concentrations of seaweed and ginger extracts in achieving the best concentrations between weight loss reductions, while maintaining Total Soluble Solids (TSS), and sprout inhibition. Mixing edible coatings with other methods of preservation, varying from modified atmosphere storage and irradiation could also be explored to enhance the shelf life while improving the quality of onion bulbs after storage. The edible coating can be tested on the other *Allium* species, such as garlic and shallots, to test its viability and effectivity in the preservation of these vegetables' high-value crops. The possibility of exploring the utilization of onion waste extracts in formulating edible coatings. The application of nanotechnology and bio-nanocomposites to enhance and improve the properties of the edible coating. By addressing and considering these limitations and exploring these extensions, future research can build upon the current findings

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leading to the development of more effective and sustainable methods of preserving onions and other produce and further helping local farmers and growers.

CONCLUSION

Based on the findings of this study, the edible coating with ginger and seaweed extract shows promise as a natural method for preserving onions. The treatments effectively managed weight loss and total soluble solids and completely inhibited rotting, which is crucial for maintaining the quality and extending the shelf life of onions. The developed edible coating aligns with sustainable practices and offers a potential alternative to synthetic preservatives.

The combination of ginger and seaweeds edible coating exhibits potential and effectively managed the weight loss of onions during the storage duration.

Evidently there were slight variations among the different treatments, all coatings helped to minimize weight loss compared to the control group, indicating the coating's barrier properties.

It also underscores that the total soluble solids of onion have been greatly influenced upon subjecting to edible coating treatment. Study revealed that a higher concentration of ginger extract appeared to reduce the total soluble solids, which could potentially slow down the ripening process and maintain the quality of the onions for a longer storing period.

The whole range of treatments, including the control, showed 0% rotten bulbs during the study period. This result indicates that the onions used in the study were of good initial quality and that the coatings did not negatively impact the incidence of rot.

The study shows a clear trend that the coatings inhibit the sprouting of the onion bulbs, and a higher concentration of ginger extracts (T4) showed a minimal sprouting percentage. This further suggests that the ginger extract may have a role in delaying or preventing sprouting in onions during storage.

With the abovementioned findings of the study, it clearly dictates that further research is highly encouraged to optimize the concentration of ginger and seaweed extracts used in the development of edible coating. Identifying the specific compounds in the extracts responsible for these effects and determining the optimal ratios for maximum preservation benefits can also be considered. Storage duration studies are also recommended to fully evaluate the long-term effectiveness of the edible coatings. These studies will assess and evaluate particularly the changes in sensory attributes, nutritional content, and microbial safety of the coated onions over a longer period to ensure consumer acceptability and safety. Exploration of the combination of edible coatings with use of other preservation techniques, such as controlled atmosphere storage or modified atmosphere packaging (MAP), could possibly enhance the shelf life and quality of onions. This could also lead to the development of integrated preservation strategies that would maximize the benefits of each technique. For consumers especially onion farmers and growers, the developed edible coating can be easily applied by dipping onions in the solution and allowing them to dry. Nevertheless, more research is needed to determine and establish the optimal coating thickness and drying conditions for home use.

Consumers should be advised to store coated onions in a cool, dry place to maximize their shelf life. The edible coating technology should also be tested on other types of produce, such as garlic, shallots, and other vegetables and fruits, to determine its broader applicability. This could help reduce post-harvest losses and improve food security for a wide range of agricultural products. Future researchers could also consider the following in their future research by incorporating microbial analysis of the test bulbs to assess the total microbial load in coated versus uncoated onion samples. Conduct comparative studies with different onion varieties. Increasing the sample size of test bulbs in future experiments. Consider the inclusion of various onion sizes, beyond medium bulbs, in subsequent research. Expand research to other agricultural commodities to further validate and strengthen the experimental findings. Encourage future research to delve deeper into the mechanisms driving the interaction between the edible coating and the physiological processes involved in the development of 'Red Dragon' onion bulbs. Conduct future research on the effectiveness of ginger and seaweed extract coating as a mold inhibitor on the other crops affected by *Aspergillus niger*. Explore the effectiveness of seaweed and ginger extract individually as a mold inhibitor of onion; consider the use of different varieties of onion adaptive to Occidental Mindoro. These recommendations are intended to guide future research endeavors and support agricultural practitioners in mitigating storage losses due to black mold through the application of plant-based extract coatings.

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REFERENCES

Abd-Alla, M. H., Bashandy, S. R., Ratering, S., & Schnell, S. (2011). First report of soft rot of onion bulbs in storage caused byPseudomonas aeruginosain Egypt. *Journal of Plant Interactions*, 6(4), 229–238. https://doi.org/10.1080/17429145.2010.535618

Abdelgawad, K. F., Shehata, S. A., El-Metwally, I. M., El-Desoki, E. R., El-Rokiek, K. G., & Elkhawaga, F. A. (2025). Efficacy of pre-harvest weed control treatments on onion bulb storability. *Scientific Reports*, 15(1). https://doi.org/10.1038/s41598-025-89970-6

Anadani, R. S. V., & Vanthana, L. a. M. (2017). Management of Black Mold of Onion [Aspergillus niger (Van Teigh)] by using Various Fungicides. *International Journal of Current Microbiology and Applied Sciences*, 6(3), 1621–1627. https://doi.org/10.20546/ijcmas.2017.603.187

Augusto, A., & Pedrosa, R. (2014). Seaweed extracts as edible coatings for minimally processed products. *Frontiers in Marine Science*, *1*. https://doi.org/10.3389/conf.fmars.2014.02.00167

Chanthini, K. M., & Senthil-Nathan, S. (2024). Marine weeds against fungal phytopathogens - Current agronomical implications and intriguing perspectives for a sustainable future. *Physiological and Molecular Plant Pathology*, 130, 102240. https://doi.org/10.1016/j.pmpp.2024.102240

Chavan, P., Lata, K., Kaur, T., Jambrak, A. R., Sharma, S., Roy, S., Sinhmar, A., Thory, R., Singh, G. P., Aayush, K., & Rout, A. (2023). Recent advances in the preservation of postharvest fruits using edible films and coatings: A comprehensive review. *Food Chemistry*, 418, 135916. https://doi.org/10.1016/j.foodchem.2023.135916

Chavez-Mendoza, C., Vega-Garcia, M., Guevara-Aguilar, A., Sanchez, E., Alvarado-Gonzalez, S., & Flores-Cordova, M. (2016). Effect of prolonged storage in controlled atmospheres on the conservation of the onion (Allium cepa L)quality. *Emirates Journal of Food and Agriculture*, 28(12), 842. https://doi.org/10.9755/ejfa.2016-06-643

Department of Agriculture. (2025). DA chief pledges onion research and extension center, boost productivity. *Official Portal of the Department of Agriculture.* https://www.da.gov.ph/da-chief-pledges-onion-research-and-extension-center-boost-productivity/

Gemida, J. V., Ardeña, R. A., & Pillones, C. T. (2023). Shelf life of tomato (Solanum lycopersicum) in different post-harvest treatments. *International Research Journal of Science, Technology, Education, & Management (IRJSTEM)*, 3(2). https://doi.org/10.5281/zenodo.8139508

Gomez, C. J. J. (2024). Onion production surge: market impact, importation ban, and support initiatives for farmers in the Philippines. *PCAARRD's Industry Strategic Science and Technology Programs.* https://ispweb.pcaarrd.dost.gov.ph/onion-production-surge-market-impact-importation-ban-and-support-initiatives-for-farmers-in-the-philippines/

Han, C., Ji, Y., Li, M., Li, X., Jin, P., & Zheng, Y. (2016b). Influence of wounding intensity and storage temperature on quality and antioxidant activity of fresh-cut Welsh onions. *Scientia Horticulturae*, 212, 203–209. https://doi.org/10.1016/j.scienta.2016.10.004

Hankar, S., Thirupathi, V., & Venugopal, A. P. (2017). Development of on farm ventilated storage system for aggregatum onion. *International Journal of Current Microbiology and Applied Sciences*, 6(6), 1354–1361. https://doi.org/10.20546/ijcmas.2017.606.159

Hatem, M. H., Shehata, S. A., AbdEl-hay, Y. B., AbdEl-Gwad, K. F., & Abaker, B. A. (2014). Effect of storage conditions on the quality of onion bulbs. *Misr journal of agricultural engineering*, 31(3), 919-936. https://doi.org/10.21608/mjae.2014.98928

Ibrahim, N. F., Rostam, N. F. S., Azman, N. A. I. N., & Razak, S. B. A. (2020). Effects of kaffir lime peel extract and ginger extract on the postharvest quality of tomato. *Malaysian Applied Biology*, 49(4), 247-251. https://doi.org/10.55230/mabjournal.v49i4.1628

Idago, R. G., Miranda, D. R., Antolin, M. C. R., & Flores, E. D. (2020). Storage performance of bulb onion (*Allium cepa* l.) in non-refrigerated storage system. *Asian Journal of postharvest and mechanization*, 3(2), 1.

Ioku, K., Aoyama, Y., Tokuno, A., Terao, J., Nakatani, N., & Takei, Y. (2001). Various cooking methods and the flavonoid content in onion. *Journal of Nutritional Science and Vitaminology*, 47(1), 78–83. https://doi.org/10.3177/jnsv.47.78

Isma'ila, M., Karu, E., Zhigila, D., & Yuguda, U. (2017). Postharvest storage and shelf-life potentials among selected varieties of onion (*Allium cepa* L.). *Scholars Academic Journal of Biosciences*. https://doi.org/10.21276/sajb

Ko, S. S., Chang, W. N., Wang, J. F., Cherng, S. J., & Shanmugasundaram, S. (2002). Storage variability among short-day onion cultivars under high temperature and high relative

humidity, and its relationship with disease incidence and bulb characteristics. *Journal of the American Society for Horticultural Science*, 127(5), 848-854. https://doi.org/10.21273/JASHS.127.5.848

Kumar, V., Neeraj, Sharma, S., & Sagar, N.A. (2015). Post Harvest Management of Fungal Diseases in Onion - A Review. *International Journal of Current Microbiology and Aplied Sciences*, (2015) 4(6): 737-752

Liakos, C., Ibanez, V., Lebre, P. H., Derie, M. L., Van Der Waals, J., Du Toit, L., Dutta, B., Kvitko, B., Cowan, D. A., & Coutinho, T. A. (2024). The Bacterial and Viral Communities Associated with Onion Bacterial Bulb Rot. *Phytobiomes Journal*. https://doi.org/10.1094/pbiomes-11-23-0121-r

Mao, Q., Xu, X., Cao, S., Gan, R., Corke, H., Beta, T., & Li, H. (2019). Bioactive Compounds and Bioactivities of Ginger (Zingiber officinale Roscoe). *Foods*, 8(6), 185. https://doi.org/10.3390/foods8060185

Nasim, N., Sandeep, I. S., & Mohanty, S. (2022). Plant-derived natural products for drug discovery: current approaches and prospects. *The Nucleus*, 65(3), 399–411. https://doi.org/10.1007/s13237-022-00405-3

Nisa, Q., Gulzar, G., Dar, M. S., Shahnaz, E., Banday, S., Bhat, Z. A., El-Sheikh, M. A., Nabi, S. U., Arya, V. M., Anwar, A., & Mansoor, S. (2024). New reports of pathogen spectrum associated with bulb rot and their interactions during the development of rot in tulip. *BMC Genomic Data*, 25(1). https://doi.org/10.1186/s12863-024-01218-w

Philippine National Standard. (2004). Fresh vegetables -- common onion (*Allium cepa* L. cv Common Onion) and shallot (*Allium cepa* L. Group Aggregatum) – Specification. http://spsissuances.da.gov.ph/attachments/article/1079/PNS-BAFS14-2004Vegetable-BulbOnionandShallots.pdf

Puccio, G., Crucitti, A., Tiberini, A., Mauceri, A., Taglienti, A., Antonio Palumbo Piccionello, Carimi, F., Martijn van Kaauwen, Scholten, O., Sunseri, F., Vosman, B., & Mercati, F. (2022). *WRKY Gene Family Drives Dormancy Release in Onion Bulbs*. *Cells*, 11(7), 1100–1100. https://doi.org/10.3390/cells11071100

Rozo, G., Gomez, D., & Rozo, C. (2016). Efecto de una biopelícula de alginato en la conservación de cebolla larga (Allium fistulosum l.). *Universidad Jorge Tadeo Lozano*. http://hdl.handle.net/20.500.12010/9518

Sohany, M., Sarker, M. K. U., & Mahomud, M. S. (2016). Physiological changes in red onion bulbs at different storage temperatures. *World Journal of Engineering and Technology*, *04*(02), 261–266. https:// doi: 10.4236/wjet.2016.42025

ROOTSTOCK COMPATIBILITY OF MAGUILAS F1 TO SELECTED HIGH YIELDING VARIETIES OF TOMATO SCION

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ABSTRACT

Tomato (Lycopersicon esculentum) is a globally significant crop, but its cultivation is severely hindered by waterlogging during the rainy season, leading to significant yield losses for farmers, particularly in areas like San Jose, Occidental Mindoro. Grafting offers a promising solution by combining high-yielding scions with waterlogging-tolerant rootstocks. This study investigated the grafting compatibility of three high-yielding tomato scion varieties (Diamante Max F1, Jewel F1, and Garnet F1) with the waterlogging-tolerant Maguilas F1 as a rootstock. Using a Completely Randomized Design (CRD) in a controlled healing chamber, we evaluated grafting success rate, height increment, and days to callus formation. Results showed that the Maguilas F1 and Diamante Max F1 combination exhibited significantly higher grafting success rates (mean = 82.22%) and greater height increments (mean = 3.47 cm) compared to Jewel F1 and Garnet F1. Diamante Max F1 also consistently formed callus earlier, indicating faster wound healing. While there was no statistically significant difference in days to callus formation across treatments, Diamante Max F1's quicker healing contributed to its superior performance. These findings highlight Diamante Max F1 as the most compatible scion for Maguilas F1 rootstock, offering a viable strategy for improving tomato cultivation during adverse rainy season conditions and potentially increasing farmer profitability and consumer access to affordable tomatoes.

Keywords*: callus, compatibility, grafting, rootstock, Solanum lycopersicum*

SDG: *SGD 2: Zero Hunger*

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INTRODUCTION

Tomato (Lycopersicon esculentum) is one of the most economically significant crops in the world (Akotowanou et al., 2022). In the Philippines, tomato is the top 25 profitable crop. The average yield per hectare is around 13,744 kg, the production cost per kilogram is PhP19.48 and the farmgate price per kilogram is PhP28.19. The gross return of tomato is PhP387,433, total cost averaging PhP267,785 and the net return is PhP119,648. Lastly, the return on investment for tomato production is 45% (Gomez, C.J.J., 2024).

However, local farmers in San Jose, Occidental Mindoro are discouraged to plant tomato during rainy season (June to August). Tomatoes cannot survive continues rain, which resulted to low yield and death of seedlings planted. Tomatoes are very sensitive to waterlogging (Pandey et al., 2021). Plant growth and development are impacted by waterlogging because it reduces the amount of oxygen that reaches the submerged tissues of plant roots (Tareq et al., 2020). Waterlogging will result in hypoxia in roots, or the insufficiency of oxygen. Oxygen is needed by root cells to perform respiration (Ide et al., 2021). Hypoxia inhibits root development, yield reduction and early senescence of leaf (Goto et al., 2022). According to Latifah et al., (2018), thirty percent less was produced by tomato plants that were water-logged for two days during their vegetative period.

One technique to lessen the detrimental effect of water logging on tomato output is by grafting the scions of tomatoes to a rootstock that are resistant to waterlogging. Grafting tomato plants on abiotic stress-tolerant rootstocks has been shown to improve yield (Turhan et al., 2015). However, in grafting, rootstock and scion compatibility test must be done. The changing availability of rootstock varieties, the relative lack of information on most of them, and the different sets of traits they contain makes selecting rootstock varieties difficult. Grafting tests are an important means for evaluating the compatibility between rootstocks and scions (Mao et al., 2022). Rootstocks are selected for rooting and grafting capacity, abiotic and biotic stress tolerance and their ability to beneficially alter scion phenotypes. Using the right rootstocks will aid tomatoes that are under water stress (Schwarz et al., 2010).

On the other hand, high yielding varieties such as Dimante Max F1, Jewel F1 and Garnet F1 will serve as scion. If positive results are obtained, this study greatly helped tomato farmers and the consumers. The cultivation of tomatoes during rainy season when supply is low and prices are high can give farmers better profit and while consumers will have access to tomato at fair price. Whereas several tomato rootstock accessions are used commercially to provide tolerances to salinity and temperature, no tomato rootstock has demonstrated a notable level of resilience to flood conditions to yet. Therefore, finding a rootstock that can withstand flooding would allow tomatoes to be grown in flooded environments. A strong candidate is eggplant, a close relative of tomatoes with numerous cultivars whose roots can withstand longer in moist soils (Petran & Hoover, 2013).

The above scenario prompted the researcher to test the compatibility of Maguilas F1 as rootstock for high yielding varieties of tomato planted by farmers. Grafting onto resistant rootstocks like Maguilas F1 can control bacterial wilt caused by Ralstonia solanacearum, achieving up to 100% control (Albuquerque et al., 2021).

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The objective of this study is to determine the grafting compatibility of different scions (Diamante Max F1, Jewel F1 and Garnet F1) to Maguilas F1 rootstock.

METHODS

Study Design

This study used the experimental method of research following laid- out in Completely Randomized Design (CRD). This is the appropriate design because the study was conducted inside a healing chamber where a cover and air cooler were installed to partially control humidity and temperature.

The treatment levels used were as follow:
T_1 – Maguilas F1 (root stock) x Diamante Max F1 (scion)
T_2 – Maguilas F1 (root stock) x Jewel F1 (scion)
T_3 – Maguilas F1 (root stock) x Garnet F1 (scion)

Study Settings

This study was conducted at the Nursery and Developmental Project of Occidental Mindoro State College, Yaw-yawi I, Murtha, San Jose, Occidental Mindoro.

Materials

Table 1. Materials used in this study.

Quantity	Unit	Materials
450	Pcs	Maguilas F1 Seedlings
150	Pcs	Diamante max F1 Seedlings
150	Pcs	Jewel F1 Seedlings
150	Pcs	Garnet F1 Seedlings
3	Pcs	Spade
5	Pcs	Blade
3	Pcs	Air cooler
1	Sack	Garden Soil
1	Sack	Organic Fertilizer
1/2	Sack	Rice Hull
450	Pcs	Grafting silicone clips
9	Pcs	Seedling trays
5	Yards	UV sheet
1	Pc	Ruler

Experimental Layout

Table 2 shows the layout of the experiment. The three (3) treatments were replicated 3 times and were randomly assigned to each plot using draw lots.

Table 2. Experimental layout of the study.

T_2R_2	T_2R_1	T_1R_1
T_3R_1	T_1R_2	T_3R_2
T_3R_3	T_2R_3	T_1R_3

Preparation of Seedlings

The growing media used in this study were garden soil, organic fertilizer and rice hull/mixed in 1:1:1 ratio. Garden soil was used because it allows good air and water movement, and it holds water very well in their small pores spaces and can drown roots. Organic fertilizer provides the necessary nutrients for the tomato seedlings to grow. Rice hull, on the other hand, helped improve drainage water holding capacity, and aeration. The media were mixed thoroughly, then it was sterilized using hot-plate method. This is to ensure that the growing mixture is free from any disease-causing organism.

The media was then poured to the seedling trays and 1 seed per hole was sown. The seedling trays were placed in the greenhouse to prevent pest and diseases infestation.

Grafting

The seedlings were grafted 25 days after germination or when the seedlings' stem diameter were already 2.5cm. Monitoring of seedlings' diameter was done using vernier caliper. Prior to grafting seedlings were hardened by slowly exposing them to sunlight.

Cleft grafting was used in this study. Prior to grafting, seedlings were watered to avoid dehydration. Using a sterilized blade, rootstock was cut 3 cm from the base of the stem. Then a 1 cm vertical cut was made from the root stock. Scion seedling with the same diameter as the rootstock were prepared. The length of the scion was 6 cm from its apical buds. The scion stem was trimmed into a wedge shape with two diagonal cuts. Then it was inserted into the rootstock. The wound was sealed using a grafting clip. A total of 30 seedlings were grafted per treatment plot.

Healing of Grafted Seedlings

After grafting, seedlings were placed in a healing chamber covered with UV sheet plastic. The healing chamber was placed in a shaded area with a bit of sunlight which favors the healing of grafted seedlings. Three air coolers were installed inside the chamber to reduce the temperature and prevent the dehydration of seedlings. Maintaining the low relative humidity (RH) through air coolers were maintained for 1 week, then gradual lowering of RH was done. The seedlings stayed in the healing area for two weeks.

Healing Chamber

A three-layer desk made of bamboo splinters and *bubutahe* tree. The chamber was 153.5 cm tall, 68 cm wide and had a length of 158 cm. Three layers of beds were constructed. The chamber will be covered with UV sheets.

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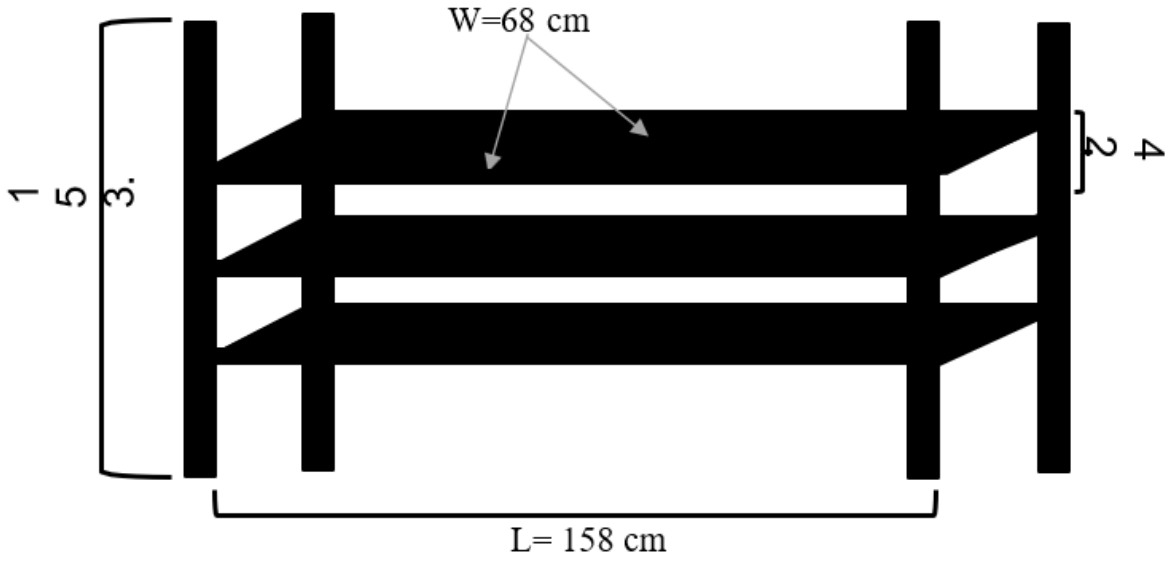

Fig. 1. Illustration of healing chamber

Water Management

Watering of grafted seedlings was done depending on the soil moisture. The grafted seedlings were watered cautiously below the grafted part using the improvised watering tool.

Unit of Analysis and Sampling

Data was measured from 20 grafted tomatoes per replication. Each plant was labelled as P1, P2, P3...P30. Twenty sample plants were randomly selected using draw lots.

Statistical Analysis

Various data were gathered from the experiment and were analyzed using the Analysis of Variance. Difference among treatments was determined using Least Significant Differences (LSD) at 5% level of significance.

Scope and Limitations

This study focused only on the rootstock compatibility of Maguilas F1 to Diamante F1, Jewel F1 and Garnet F1 scion. Therefore, the results of this study are limited only in the mentioned varieties. Growth and yield response of grafted tomatoes were within the scope of this study. The result of this study was limited only to cleft grafting. Grafting conducted when the seedlings' stem diameter was already 2.5cm. The study duration was for twenty-one days. After grafting, seedlings were placed in a healing chamber covered with UV sheet plastic. The healing chamber was placed in a shaded area with a bit of sunlight which favors the healing of grafted seedlings.

RESULTS

Grafting Success Rate

This data presents three treatments (T_1, T_2, T_3) with their respective success rates across three repetitions (R_1, R_2, R_3), along with total and mean success rates. T_1 (Diamante F1) has the highest mean (82.22%) success rate, followed by T_2 Jewel F1 (72.22%). On the other hand, grafted T_3 Garnet F1 had the lowest (68.89%) success rate.

Table 3. Rootstock compatibility of Maguilas F1 to selected high yielding varieties of tomato scion in terms of success rate (%).

TREATMENT	REPLICATION			TREATMENT TOTAL	TREATMENT MEAN
	R_1	R_2	R_3		
T_1 (Diamante Max F1)	76.67	83.33	86.67	246.67	82.22 a
T_2 (Jewel)	66.67	76.67	73.33	216.67	72.22 b
T_3 (Garnet)	66.67	73.33	66.67	206.67	68.89 b
Grand Total				670.00	
Grand Mean					74.44

Legend: Mean(s) with the same letter(s) do not differ significantly by the Least Significant Difference (LSD) at 5% level.

Furthermore, Table 4 presents the Analysis of Variance in CRD for Rootstock Compatibility of Maguilas F1 to selected high yielding varieties of tomato scion in terms of grafting success rate (%). The result shows that the computed P-value (0.03), which is higher than critical value of 5.14 suggest that there is a significant difference among the treatments, meaning that the treatments have a statistically significant effect on the outcome. On the other hand, the compatibility with T_1, T_2 and T_3 with mean of 82.22%, 72.22% and 68.89% are significantly different among treatments as determined by LSD at 5% level of significance. Thus, the experiment rejected the null hypothesis.

Table 4. Analysis of Variance in CRD for Rootstock compatibility of Maguilas F1 to selected high yielding varieties of tomato scion in terms of success rate (%).

Source of Variation	df	SS	MS	F	P-value	F crit
Treatment	2	288.89	144.44	6.50*	0.03	5.14
Error	6	133.33	22.22			
-Total	8	422.22				

**Significant, CV=6.33%*

Height Increment

Table 5 shows the height increment of grafted tomatoes. The increased in height of grafted varies significantly depending on the varieties used as a scion. The combination of Maguilas F1 and Diamante Max F1 variety significantly produced taller (mean=3.47 cm) plants compared to Jewel F1 (mean=2.20 cm) and Garnet F1 (mean=2.30 cm). This result further verifies the compatibility of Maguilas F1 (rootstock) and Diamante Max F1 (scion). The result in increased height could attributed to early callusing of Diamante Max F1

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Table 5. Rootstock compatibility of Maguilas F1 to select high yielding varieties of tomato scion in terms of height increment (cm).

TREATMENT	REPLICATION			TREATMENT TOTAL	TREATMENT MEAN
	R_1	R_2	R_3		
T_1 (Diamante Max F1)	4.00	3.10	3.30	10.40	3.47 a
T_2 (Jewel)	2.00	2.20	2.40	6.60	2.20 b
T_3 (Garnet)	2.10	2.70	2.10	6.90	2.30 b
			Grand Total	23.90	
			Grand Mean		7.97

Legend: Mean(s) with the same letter(s) do not differ significantly by the Least Significant Difference (LSD) at 5% level.

Table 6 presents the Analysis of Variance in CRD for rootstock compatibility of Maguilas F1 to select high yielding varieties of tomato scion in terms of height increment (cm). The ANOVA result shows highly significant difference among treatments, it posted a computed P-value of 0.01, which is much lower than allowable limit of 0.05. Test revealed that there is highly significant difference among T1, T2, and among T3. Thus, the experiment rejected the null hypothesis.

Table 6. Analysis of Variance in CRD for Rootstock Compatibility of Maguilas F1 to select high yielding varieties of tomato scion in terms of height increment (cm).

Source of Variation	df	SS	MS	F	P-value	F crit
Treatment	2	2.98	1.49	11.64**	0.01	5.14
Error	6	0.77	0.13			
Total	8	3.74				

***Highly Significant, CV=4.52%*

Days to Callus Formation

Table 7 shows that the days to callus formation in the point of junction between rootstocks and scion between varieties of tomatoes. Consistently, Diamante Max F1 developed callus on the point of junction earlier than Jewel F1 and Garnet F1 varieties. This implies that Diamante Max F1 healed its wound faster than the two said varieties. This also explains why Diamante F1 has higher success rates and higher height increment.

Table 7. Rootstock compatibility of Maguilas F1 to selected high yielding varieties of tomato scion in terms of number of days to callus formation

TREATMENTS	REPLICATION			TREATMENT TOTAL	TREATMENT MEAN
	R_1	R_2	R_3		
T_1 (Diamante Max F1)	13.48	13.92	13.85	41.24	13.75
T_2 (Jewel)	14.15	14.17	14.13	42.45	14.15
T_3 (Garnet)	14.15	13.86	14.15	42.16	14.05
			Grand Total	125.86	
			Grand Mean		41.95

Table 8 presents the analysis of variance in CRD the number of days to callus formation after grafting. Result show by the computed P-value (0.050) that there is no significant difference among treatment groups at the 5% level. This is lower than the critical value of 5.143 at 5% level of significance. Thus, the experiment failed to reject the null hypothesis.

Table 8. Analysis of Variance in CRD for the Rootstock Compatibility of Maguilas F1 selected high yielding varieties of tomato scion in terms of number of days to callus formation.

Source of Variation	df	SS	MS	F	P-value	F crit
Treatment	2	0.266	0.133	4.76	0.050	55.143
Error	6	0.168	0.028			
Total	8	0.434				

Not Significant, CV= 1.19%

DISCUSSION

Diamante Max F1 had the highest success rate (mean=82.22%) and were found to be significantly higher compared to Jewel and Garnet F1. This implies that Diamante Max F1 has higher rate of survivability compared to Jewel F1 and Garnet F1 in terms of success rate. This positive outcome is attributed to the fast recovery and superior adaptability of Diamante max F1 than Jewel and Garnet F1. The adaptability of grafted seedlings depends on the ability to recover when under stress. Varieties with high adaptability tend to have higher rate of survivability (Duan et al., 2023). One factor that contributes to success rate of graft is the speed of callus formation in wounds. Varieties that heal earlier tend to have higher success rate and adjust faster. Additionally, varieties with such characteristics are compatible to use as scion.

Another factor is the adaptability of scion to low humidity. Low humidity can cause disease occurrence. Increasing relative humidity significantly increased the percentage of diseased plants during the healing and acclimatization period. High diseased plant was the cause in the reduction and final survival rate of grafted tomato under high humidity conditions. This further explains the superiority of Diamante max F1 in terms of resiliency and adaptability (Vu et al., 2013)

Scion significantly influences the growth characteristics of grafted tomatoes. It was also revealed that grafted seedlings that heals faster had higher biomass and height increments (Mahbou et al., 2022). The type of scion (variety) used in grafting can influence the growth of the grafted tomato plant. For example, certain scions may exhibit greater height gain than others. Faster healing of the graft union between the rootstock and scion is associated with higher biomass and height increments. This indicates that the plant's ability to quickly establish a connection between the two parts affects its growth potential (Cacayurin et al., 2024). Rootstocks and scions can have varying levels of compatibility and may impact the growth of the grafted tomato. The interaction between rootstock and scion can influence factors like fruit quality, yield, and disease resistance (Mauro et al., 2020). Environmental factors such as light, wind, and temperature can also affect graft-take and the growth of grafted tomato seedlings (Ding et al., 2023). Faster-healing grafted seedlings exhibit higher biomass and height increments compared to slower-healing seedlings. This suggests that the scion's

health and vigor play a crucial role in the overall growth and development of the grafted tomato plant (Khopade et al., 2025).

The accelerated wound healing process in Diamante max F1 tomatoes compared to Jewel F1 and Garnet F1 tomatoes can be attributed to several underlying mechanisms, primarily involving enhanced cellular responses and signaling pathways. Wounding in grafted planted induces the expression of wound induced dedifferentiation. This mechanism is mediated by auxin and cytokinin (Daniello et al., 2024). There is an increased amount of auxin and cytokinin in grafted tomato, especially on its wound. Increased auxin and cytokinin content promote callus formation at the wound union. Conversely, while Diamante max F1 exhibits superior healing capabilities, Jewel F1 and Garnet F1 may have less efficient wound induced dedifferentiation, potentially leading to slower wound healing responses (Duan et al., 2023).

CONCLUSION

Based on the finding's compatibility of Maguilas as rootstock varies depending on varieties of tomato. Maguilas F1 and Diamante Max F1 scion consistently performed the best across all parameters, with the highest success rate, the greatest height increment, and the shortest time to callus formation. This variety is recommended as the most effective, given its statistically superior performance across all measured outcomes. There is significant difference on the rootstock compatibility of Maguilas F1 and the different varieties of tomato scion.

Based on the relevant findings the researcher recommends utilizing metal equipment when constructing a healing chamber. Use Maguilas F1 as rootstock and Diamante max F1 as scion in tomato production. Conduct a follow-up study on the growth and yield performance of the grafted varieties of tomato. Comparative analysis of different varieties of tomatoes used in the study.

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REFERENCES

Akotowanou, N. O. C. A., Adjou, N. E. S., Olubi, N. a. B., Kougblenou, N. S. D., Ahoussi, N. E. D., & Sohounhloué, N. D. C. (2022). The tomato (Solanum lycopersicum L.) in community development: An overview focused on nutritional properties, agronomic constraints, reThe tomato (Solanum lycopersicum L.) in community development: An overview focuscent achievements and future prospective. *International Journal of Frontiers in Biology and Pharmacy Research*, *3*(2), 008–016. https://doi.org/10.53294/ijfbpr.2022.3.2.0061

Albuquerque, G. R., Lucena, L. P., Assunção, E. F., Mesquita, J. C. P., Silva, A. M. F., Souza, E. B., Nicoli, A., & Gama, M. a. S. (2021). Evaluation of tomato rootstocks to Ralstonia solanacearum and R. pseudosolanacearum in Mata mesoregion, PE. *Horticultura Brasileira, 39(1), 72–78*. https://doi.org/10.1590/s0102-0536-20210111

Cacayurin, C. A., Cacal, D. M., & Ronquillo, S. R. (2024). Effect of different rootstocks and scion ages on the productivity of screenhouse grown tomato (Solanum lycopersicum). *Journal of Asian Scientific Research*, *14*(1), 50–57. https://doi.org/10.55493/5003.v14i1.4988

Daniello, V., De Leo, V., Lasalvia, M., Hossain, M. N., Carbone, A., Catucci, L., Zefferino, R., Ingrosso, C., Conese, M., & Di Gioia, S. (2024). Solanum lycopersicum (Tomato)-Derived Nanovesicles Accelerate Wound Healing by Eliciting the Migration of Keratinocytes and Fibroblasts. *International Journal of Molecular Sciences, 25(5), 2452*. https://doi.org/10.3390/ijms25052452

Ding, X., Miao, C., Li, R., He, L., Zhang, H., Jin, H., Cui, J., Wang, H., Zhang, Y., Lu, P., Zou, J., Yu, J., Jiang, Y., & Zhou, Q. (2023). Artificial light for improving tomato recovery following grafting: transcriptome and physiological analyses. *International Journal of Molecular Sciences*, *24*(21), 15928. https://doi.org/10.3390/ijms242115928

Duan, Y., Zhang, F., Meng, X., & Shang, Q. (2023). Spatio-temporal dynamics of phytohormones in the tomato graft healing process. Horticultural Plant Journal. https://doi.org/10.1016/j.hpj.2022.11.0

Gomez, C. J. J. (2024). Tomato Price surge and Market Dynamics: Assessing supply, price fluctuations, and strategies for stability and international expansion. *PCAARRD's Industry Strategic Science and Technology Programs*. https://ispweb.pcaarrd.dost.gov.ph/tomato-price-surge-and-market-dynamics-assessing-supply-price-fluctuations-and-strategies-for-stability-and-international-expansion/

Goto, K., Yabuta, S., Tamaru, S., Ssenyonga, P., Emanuel, B., Katsuhama, N., & Sakagami, J. (2022). Root hypoxia causes oxidative damage on photosynthetic apparatus and interacts with light stress to trigger abscission of lower position leaves in Capsicum. *Scientia Horticulturae*, *305*, 111337. https://doi.org/10.1016/j.scienta.2022.111337

Ide, R., Ichiki, A., Suzuki, T., & Jitsuyama, Y. (2021). Analysis of yield reduction factors in processing tomatoes under waterlogging conditions. *Scientia Horticulturae*, *295*, 110840. https://doi.org/10.1016/j.scienta.2021.110840

Khopade, R. Y., Sawargaonkar, G. L., Rakesh, S., Davala, M. S., K, N. K. K., Siddam, Y., Singh, R., & Jat, M. L. (2025). Vegetable grafting: a scientific innovation to enhance productivity and profitability of tomato growers under climate change. *Frontiers in Agronomy*, *7*. https://doi.org/10.3389/fagro.2025.1514673

Latifah, E., Widaryanto, E., Magh, M. D., & Ariffin. (2018). Effect of Water logging Duration on Growth Phases of Tomatoes (Solanum lycopersicum L.) Grafted on Eggplant Rootstock. *Journal of Agronomy*, *18*(1), 11–20. https://doi.org/10.3923/ja.2019.11.20

Mahbou, S. T. G., Ntsomboh-Ntsefong, G., Aminatou, M. F., Lessa, F. T., Onana, G. E., & Youmbi, E. (2022). Effect of Grafting on Growth and Shelf Life of Tomatoes (<i>Solanum lycopersicum</i> L.) Grafted on Two Local <i>Solanum</i> Species. *Advances in Bioscience and Biotechnology*, *13*(09), 401–418. https://doi.org/10.4236/abb.2022.139026

Mao, Y., Cui, X., Wang, H., Qin, X., Liu, Y., Hu, Y., Chen, X., Mao, Z., & Shen, X. (2022). Study of the grafting compatibility of the apple rootstock 12–2, resistant to apple replant diseases (ARD). *BMC Plant Biology, 22(1).* https://doi.org/10.1186/s12870-022-03847-8

Mauro, R. P., Agnello, M., Onofri, A., Leonardi, C., & Giuffrida, F. (2020). Scion and rootstock differently influence growth, yield and quality characteristics of cherry tomato. *Plants*, *9*(12), 1725. https://doi.org/10.3390/plants9121725

Pandey, A. K., Singh, A. G., Gadhiya, A. R., Kumar, S., Singh, D., & Mehta, R. (2021). Current approaches in horticultural crops to mitigate waterlogging stress. In *Elsevier eBooks* (pp. 289–299). https://doi.org/10.1016/b978-0-12-822849-4.00014-0

Petran, A., & Hoover, E. (2013). Solanum torvum as a Compatible Rootstock in Interspecific Tomato Grafting. *Journal of Horticulture, 01(01).* https://doi.org/10.4172/2376-0354.1000103

Schwarz, D., Rouphael, Y., Colla, G., & Venema, J. H. (2010). Grafting as a tool to improve tolerance of vegetables to abiotic stresses: Thermal stress, water stress and organic pollutants. *Scientia Horticulturae*, *127*(2), 162–171. https://doi.org/10.1016/j.scienta.2010.09.016

Tareq, M. Z., Sarker, M. S. A., Sarker, M. D. H., Moniruzzaman, M., Hasibuzzaman, A. S. M., & Islam, S. N. (2020). Waterlogging stress adversely affects growth and development of Tomato. *Asian Journal of Crop Soil Science and Plant Nutrition*, *2*(1), 44–50. https://doi.org/10.18801/ajcsp.020120.07

Turhan, A., Ozmen, N., Serbeci, & Seniz, V. (2011). Effects of grafting on different rootstocks on tomato fruit yield and quality. *Horticultural Science*, *38*(4), 142–149. https://doi.org/10.17221/51/2011-hortsci

Vu, N., Zhang, C., Xu, Z., Kim, Y., Kang, H., & Kim, I. (2013). Enhanced graft-take ratio and quality of grafted tomato seedlings by controlling temperature and humidity conditions. *Protected Horticulture and Plant Factory*, *22*(2), 146–153. https://doi.org/10.12791/ksbec.2013.22.2.146

RESEARCH ARTICLE

EFFECTIVENESS OF ONLINE INTERACTIVE SIMULATION LABORATORY IN IMPROVING THE PERFORMANCE IN MOTION IN TWO DIMENSIONS OF GRADE 9 STUDENTS IN SAN JOSE ADVENTIST ACADEMY

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ABSTRACT

This study examined the effectiveness of online interactive simulations, specifically the CK-12-Physics Simulation, in enhancing physics education, with a particular focus on the challenging concept of motion in two dimensions. Recognizing the difficulties students encounter with this topic, as evidenced by PISA assessments, the researchers sought to determine if the simulation-based approach could outperform traditional teaching methods.

To investigate this, 40 ninth-grade students were divided into two groups: one exposed to interactive simulations and the other following a conventional curriculum. Both groups underwent five learning sessions tailored to their respective methods. Subsequently, all students completed a test on motion in two dimensions.

The findings were evident: the simulation group performed significantly higher post-test scores compared to their counterparts. This compelling evidence underscores the superior effectiveness of online interactive simulations in facilitating student comprehension and performance in the domain of motion in two dimensions. The study's results advocate for the integration of such technology into physics instruction to optimize learning outcomes.

Keywords: *conventional teaching, motion in two dimensions, online interactive simulation laboratory, physics education, science 9*

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INTRODUCTION

A nation's progress is contingent on its educational system. Education paced with the advancement of technology is a hallmark of a developed nation. Technology is fundamentally linked with education in the field of science. Science is a central component within the curriculum as it advances the socio-scientific development of the society. Among the different branches of science, physics stands out due to its emphasis on analytical reasoning and problem-solving skills. It aims to explain the physical world through the application of mathematical analysis and conceptual understanding. However, despite its importance, physics is often perceived as one of the most challenging subjects in the curriculum (Sarabi & Gafoor, 2018).

The performance of Filipino students in science remains a pressing concern. In the 2022 Program for International Student Assessment (PISA), only 23% of 15-year-old Filipino students reached at least the minimum proficiency level in science, far below the average of 76%. The assessment focused on concepts such as motion and forces (e.g. velocity, friction) and action at a distance (e.g. magnetic, gravitational and electrostatic forces), which are very relevant in Physics. The recent exam, despite emphasizing mathematics and incorporating a creative thinking assessment, maintained consistency with the 2015 and 2018 frameworks. The statement implied that the Philippines, having come in third to last out of 81 participating countries, indicates severe deficiencies in learning (PISA, 2022; Marôco, 2024).

Traditional instructional approaches, which primarily rely on lectures and textbooks, often fail to address the diverse learning styles of students. These methods may also limit students' engagement and motivation to learn (Hannel & Cuevas, 2018). The integration of information and communication technologies (ICTs) in teaching science opens new possibilities for approaches. Subjects like physics, where abstract ideas cannot be demonstrated in a lab, blended and virtual learning tools make visualization and interactive experimentation possible (Abdulrahaman et al., 2020). Studies with the Physics Education Technology (PhET) simulations show improved concept understanding when used alternately with traditional methods (Rutten, 2014). Active learning id encouraged through these simulations and students are able to manipulate variables which leads to the observation of results and development of higher-order thinking skills (Gnesdilow, 2021; Mešić et al., 2021; Sullivan, 2017). However, existing research offers varying results regarding the overall effectiveness of simulation-based instruction, indicating the need for further empirical investigation.

This study aims to determine the effectiveness of online interactive simulations– specifically CK-12 Physics Simulation–in teaching motion in two dimensions to Grade 9 students at San Jose Adventist Academy. It explores whether this approach leads to better student performance compared to conventional methods.

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METHODS

Study Design

This study employed a quasi-experimental design in assessing the efficacy of the CK-12 Physics Simulation on Grade 9 students' performance on Motion in Two Dimensions. Unlike true experimental designs, quasi-experiments work with pre-assigned groups, with the intent of establishing causal relationships between variables. This approach helped the researches to evaluate one group taught by traditional methods and another group taught using simulation-based teaching (Siedlecki, 2020).

This approach was selected because it is more realistic for educational settings where randomization is impossible, and some variables cannot be manipulated for ethical or practical reasons. Though the internal validity of this design may not be as strong as that of true experiments, the use of non-intrusive methods increases the likelihood of obtaining results that can be generalized to broader contexts.

In this case, it was possible to achieve the goal of determining if a notable difference in the performance of Grade 9 students at San Jose Adventist Academy subjected to conventional teaching methods versus those utilizing online interactive simulation laboratories tailored for grade 9 lessons.

Study Site

The study was conducted at San Jose Adventist Academy, San Jose, Occidental Mindoro, during the Academic Year 2023–2024. The school was chosen because it lacks a physical science laboratory and has limited equipment. The study aimed to assess whether online simulations like CK-12 Physics Simulations could enhance student understanding despite these limitations.

Unit of Analysis and Sampling

The unit of analysis for this study were Grade 9 students of San Jose Adventist Academy for the Academic Year 2023-2024, focusing on their performance in motion in two dimensions through online interactive simulation laboratories using CK-12 Physics Simulation.

The sampling units consisted of two specific sections of Grade 9 students taking the Science subject. The researchers employed a complete enumeration sampling technique, involving the entire population to eliminate sampling bias. A total of 40 participants were selected based on their relevance to the study as we studied motion in two dimensions during the fourth quarter of the academic year. Each setup involved 20 respondents from specified sections, included in the overall participant count.

Research Instrument

Parallel pre-tests and post-tests, adapted from the DepEd Science 9 module, assessed understanding of motion in two dimensions. The pre-test assessed baseline knowledge, while the post-test evaluated learning gains. A set of two formative quizzes were also prepared and administered to reinforce concepts and track learning progress across the instructional phase. Each quiz consisted of 15 items, tailored to match the students' performance and abilities

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observed during instructions. All instruments were validated by science teachers and modified according to their suggestions.

Data Collection Procedure

The principal granted permission prior to data collection from the school. Both groups were given a pre-test to assess their initial knowledge. The control group was given instruction the traditional way, while the experimental group used CK-12 Physics Simulations. Instruction was delivered over five learning sessions during the fourth quarter of the school year. Quizzes were administered after the second and fourth sessions. Two post-tests were given: one immediately after the intervention and another after a short interval to assess learning retention and consistency.

Ethical Considerations

Informed consent was obtained from all participants. Confidentiality was strictly maintained, and data were handled responsibly. The researchers upheld honesty, fairness, and proper acknowledgment of all sources throughout the study.

Data Processing and Analysis

Statistical tools were used to process and interpret the results. Descriptive statistics such as mean, frequency, standard deviation, and percentage were used to summarize and describe the performance data.

To compare the academic performance of the control and experimental groups, an independent samples t-test was employed. This statistical test determined whether there were significant differences between the mean scores of the two unrelated groups both before and after the intervention.

To measure within-group changes, a paired samples t-test was used. This test analyzed the differences between the pre-test and post-test scores of the same group to determine whether the observed improvements were statistically significant or could be attributed to chance.

These analyses enabled the researchers to draw valid conclusions regarding the effectiveness of the CK-12 Physics Interactive Simulation as a teaching tool in enhancing students' conceptual understanding of Motion in Two Dimensions.

RESULTS

Pre-Test Performance of Students

The pre-test showed that both groups similarly had low level of prior knowledge. The conventional method group had a mean of 5.55 (SD = 1.146), while the OISL group had 5.40 (SD = 0.995) [Table 1].

Table 1. Students' level of performance in motion in two dimensions before taught using conventional teaching methods and online interactive simulation laboratory as measured by the pre-test.

Pre-test	Mean	SD	Interpretation
Conventional teaching method	5.55	1.146	Did not meet expectations
Online interactive simulation laboratory	5.40	.995	Did not meet expectations

Legend: 0.00 – 7.99 – Did not meet expectations; 8.00 – 9.99 – Fairly Satisfactory; 10.00 – 11.99 – Satisfactory; 12.00 – 13.99 – Very Satisfactory; 14.00 – 15.00 – Outstanding

Difference in Pre-Test Performance of Students Between Two Dimensions

The independent samples t-test revealed no significant difference between the two groups' pre-test scores (p = 0.661) [Table 2].

Table 2. Independent samples t-test between the performance of the students in their pre-test.

	Mean Difference	t-value	Df	p-value	Interpretation
Pre-test (Control-Experimental)	.1500	.442	38	.661	Not Significant

Legend: p-value ≤ 0.05 – Significant

Post-Test Performance of Students

Post-test results showed that the OISL group scored higher (14.25, SD = 0.786) than the conventional group (11.50, SD = 1.100), indicating better performance with OISL [Table 3].

Table 3. Level of performance of the students in motion in two dimensions taught using conventional teaching method and online interactive simulation laboratory as measured by the post-test.

Post-test	Mean	SD	Interpretation
Conventional teaching method	11.50	1.100	Satisfactory
Online interactive simulation laboratory	14.25	0.786	Outstanding

Legend: 0.00 – 7.99 – Did not meet expectations; 8.00 – 9.99 – Fairly Satisfactory; 10.00 – 11.99 – Satisfactory; 12.00 – 13.99 – Very Satisfactory; 14.00 – 15.00 – Outstanding

Difference in Post-Test Performance of Students Between Two Dimensions

A paired sample t-test showed significant improvement in both groups from pre-test to post-test (t = 21.93, p = 0.000) [Table 4].

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Table 4. Paired t-test between the performance of the students in the pre-test and post-test using conventional teaching method and online interactive simulation laboratory.

	Mean Difference	t-value	Df	p-value	Interpretation
Pre-test (Control-Experimental) - Post-test (Control-Experimental)	-7.400	21.93	39	0.000	Significant

Legend: p-value ≤ 0.05 – Significant

Difference Between Pre-Test and Post-Test in their OISL Performance

The OISL group also showed a significant improvement in their scores, with a mean difference of 9.825 (t = 13.603, p = 0.000) [Table 5].

Table 5. One-sample t-test between the performance of the students in the pre-test and post-test using online interactive simulation laboratory.

	Mean Difference	t-value	Df	p-value	Interpretation
Experimental (Pre-test - Post-test)	9.825	13.603	39	0.000	Significant

Legend: p-value ≤ 0.05 – Significant

Difference in Post-Test Performance of Students Between Two Dimensions

The independent samples t-test between the post-test results of both groups showed a significant difference (t = 9.094, p = 0.000), with OISL students outperforming those taught using the conventional method [Table 6].

Table 6. Independent samples t-test between the performance of the students in post-test using conventional teaching method and online interactive simulation laboratory.

	Mean Difference	t-value	Df	p-value	Interpretation
Post-test (Control-Experimental)	-2.75	9.094	38	0.000	Significant

Legend: p-value ≤ 0.05 – Significant

DISCUSSION

A study not that there were no significant differences in the pre-test score outcomes for instructional groups in teaching physics. Such an outcome is in line with studies which indicate that learners perceive the subject of physics to be challenging due to its abstract nature and high reliance on mathematical frameworks (Seifan et al., 2020; Akpinar, 2014; Karacop & Doymus, 2013). Understanding the gaps are well documented, especially in scalar and vector quantities, displacement, and acceleration (Handhika et al., 2019; Motlhabane, 2016; Defianti & Rohmi, 2021).

Post-test results showed significant improvement relative to the pre-test, particularly among students in the Online Interactive Simulation Laboratory (OISL) group. These students performed better than those in the conventional teaching group, suggesting that simulations enhance learning and retention. These results confirm the claims made by Aljuhani et al. (2018), who reported the effectiveness of simulation-based environments in promoting engagement and deeper understanding. Fallon (2019) further emphasized the role of simulations in fostering higher-order thinking and inquiry-based learning.

Within the OISL group, the paired samples t-test confirmed significant gains from pre- to post-test, affirming the effectiveness of simulation-based instruction. Students improved performance with innovative teaching strategies. Simulations appear particularly beneficial for subjects requiring abstract reasoning, like physics (Parno et al., 2020; Alqarni, 2021)

The value of simulation was underscored by an average increase of 9.825 in the OISL group, which a single-sample t-test validated, reflecting almost three standard deviations in the mean shift. According to Deriba et al., (2024), virtual experimentation can be a powerful tool for students to learn and master complex concepts. By providing safe, reproducible, and often gamified learning environments, virtual labs allow students to explore, experiment, and understand intricate ideas in a way that traditional methods might not allow. Akpinar (2014) noted the importance of animated and interactive educational materials in explaining abstract concepts in the study of physics.

Using an independent samples t-test, the comparative post-test analysis yielded OISL group results that were statistically significantly higher than the Control group results, indicating that students learn better in interactive technology-supported environments than the Control group results, indicating that students learn better in interactive technology-supported environments than through traditional lectures. These findings are supported in studies conducted by Chan et al. (2021), and Bautista and Boone (2015) which noted that student motivation, confidence, and achievement are enhanced by simulations. Balaji et al. (2020) also noted that students can safely learn from their mistakes because simulations replicate real lab environments.

It was concerned with one topic of physics within a certain context, which may not be broadly applicable. It also did not take into account student's attitude, engagement level, or retention over time.

Regardless of these limitations, the study supports the integration of online interactive simulations into science education, especially at the secondary level. These tools can enhance learning in conceptually challenging areas. Future research should examine the long-term impact of simulation-based instruction across different science subjects and explore its influence on motivation, critical thinking, and collaboration

CONCLUSION

This study showed that both students in the experimental group and in the control group demonstrated low performance in the pre-test indicating that they had little knowledge of the topic beforehand, prior to the lessons being taught. There was also improvement in the post test scores for both groups. However, students taught using the OISL performed better than those taught through the conventional method. This indicates that OISL is indeed more effective in promoting students' understanding and retention of the subject matter.

The interactive features of the simulation allowed students to explore the lesson more deeply and learn at their own pace, leading to better results. The significant improvement from pre-test to post-test in the OISL group supports the conclusion that virtual labs can improve student learning in science. This finding confirms that OISL helps students learn difficult concepts like projectile motion more easily and with greater interest. One limitation of this study is the small number of students and the short time of implementation. Future research can involve more students, different grade levels, or longer periods of instruction to get more reliable results.

Based on the findings, it is recommended that schools and teachers use virtual labs as part of regular science teaching. These tools can make lessons more engaging and help students understand complex topics. Teachers should be trained to use these technologies effectively, and schools should invest in making these tools available to support better learning for all students.

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REFERENCES

Abdulrahaman, M., Faruk, N., Oloyede, A., Surajudeen-Bakinde, N., Olawoyin, L., Mejabi, O., Imam-Fulani, Y., Fahm, A., & Azeez, A. (2020). Multimedia tools in the teaching and learning processes: A systematic review. *Heliyon*, *6*(11), e05312. https://doi.org/10.1016/j.heliyon.2020.e05312

Akpınar, E. (2014). The use of interactive computer animations based on POE as a presentation tool in primary science teaching. *Journal of Science Education Technology*, 23:527-537. https://doi: 10.1007/s10956-013-9482-4

Aljuhani, K., Sonbul, M., Althabiti, M., Meccawy, M., (2018). Creating a Virtual Science Lab (VSL): the adoption of virtual labs in Saudi schools. *Smart Learning Enviremonets.* https://doi.org/10.1186/s40561-018-0067-9

Alqarni, T. (2021). Comparison of Augmented Reality and Conventional Teaching on Special Needs Students' Attitudes towards Science and Their Learning Outcomes. *Journal of Baltic Science Education*, *20*(4), 558–572. https://doi.org/10.33225/jbse/21.20.558

Balaji, B., Mallya, S., Genc, S., Gupta, S., Dirac, L., Khare, V., Roy, G., Sun, T., Tao, Y., Townsend, B., Calleja, E., Muralidhara, S., Karuppasamy, D., (2020). DeepRacer: Autonomous Racing Platform for Experimentation with Sim2Real Reinforcement Learning. *2020 IEEE International Conference on Robotics and Automation (ICRA), Paris, France, 2020, pp. 2746-2754*. https://doi.org/10.1109/ICRA40945.2020.9197465

Bautista, N. U., & Boone, W. J. (2015). Exploring the impact of TeachMETM Lab Virtual Classroom teaching simulation on Early Childhood education majors' Self-Efficacy beliefs. *Journal of Science Teacher Education*, *26*(3), 237–262. https://doi.org/10.1007/s10972-014-9418-8

Chan, P., Gerven, T., Dubois, J-L., Bernaert, K., (2021). Virtual chemical laboratories: A systematic literature review of research, technologies and instructional design. Computers and Education Open, 2, 100053. https://doi.org/10.1016/j.caeo.2021.100053

Defianti, A. and Rohmi, P (2021). Undergraduate student's misconception about projectile motion after learning physics during the Covid-19 pandemic era. *J. Phys.: Conf. Ser.* 2098 012026. https://iopscience.iop.org/article/10.1088/1742-6596/2098/1/012026/pdf

Deriba, F. G., Saqr, M., & Tukiainen, M. (2024). Assessment of accessibility in virtual laboratories: a systematic review. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1351711

Fallon, G. (2019). Using simulations to teach young students science concepts: An experiential learning theoretical analysis. *Computers & Education,* 135, 138–159. https://doi.org/10.1016/j.compedu.2019. 03.001

Gnesdilow, D., & Puntambekar, S. (2021) Comparing Middle School Students' Science Explanations During Physical and Virtual Laboratories. *Journal of Science Education and Technology,* 1-12. https://doi.org/10.1007/s10956-021-09941-0

Handhika, J., Mayasari, T., Huriawati, F., Yusro, A. C., Sasono, M., Purwandari, P., & Kurniadi, E. (2018). The students conception about Kinematics - Displacement and Distance concept. *Proceedings of the Annual Conference on Social Sciences and Humanities*, 142–146. https://doi.org/10.5220/0007416801420146

Hannel, S. L., & Cuevas, J. (2018). A study on science achievement and motivation using computer-based simulations compared to traditional hands-on manipulation. *Georgia Educational Researcher*, *15*(1). https://doi.org/10.20429/ger.2018.15103

Karacop, A., & Doymus, K. (2012). Effects of Jigsaw cooperative learning and animation techniques on students' understanding of chemical bonding and their conceptions of the particulate nature of matter. *Journal of Science Education and Technology*, *22*(2), 186–203. https://doi.org/10.1007/s10956-012-9385-9

Marôco, J., Harju-Lukkainnen, H., & Rautopuro, J. (2024). Worldwide predictors of science literacy in lower-secondary students: a TIMSS 2019 analysis. *International Journal of Science Education*, 1–19. https://doi.org/10.1080/09500693.2024.2394239

Mešić, V., Jusko, A., Beatović, B., & Fetahović-Hrvat, A. (2021). Improving the Effectiveness of Physics Homework: A Minds-on Simulation-Based approach. *European Journal of Science and Mathematics Education*, *10*(1), 34–49. https://doi.org/10.30935/scimath/11383

Motlhabane, A. (2016). Learner's Alternative and Misconceptions in Physics: A Phenomenographic Study. *Journal of Baltic Science Education*, 15(4), 424–440. https://doi.org/10.33225/jbse/16.15.424

Organization for Economic Co-operation and Development. (2023), PISA 2022 Results: Factsheets Philippines. https://www.oecd.org/publication/pisa-2022-results/country-notes/philippines-a0882a2d/

Parno, P., Yuliati, L., Hermanto, F. M., & Ali, M. (2020). A Case Study on Comparison of High School Students' Scientific Literacy Competencies Domain in Physics with Different Methods: Pbl-Stem Education, Pbl, and Conventional Learning. *Jurnal Pendidikan IPA Indonesia*, *9*(2), 159–168. https://doi.org/10.15294/jpii.v9i2.23894

Program for International Student Assessment (PISA). (2017). PISA 2015 Assessment and Analytical Framework . In *Programme for international student assessment/Internationale Schulleistungsstudie*. https://doi.org/10.1787/9789264281820-en

Rutten, N. (2014). Teaching with simulations *(print). [PhD Thesis - Research UT, graduation UT, University of Twente]. University of Twente*. https://doi.org/10.3990/1.9789402119589

Sarabi, M. K., & Gafoor, K. A. (2018). Student Perception on Nature of Subjects: Impact on Difficulties in Learning High School Physics, Chemistry and Biology. *Innovations and Researches in Education Volume 8(1). 42-55. ISSN-2231-4148.* https://eric.ed.gov/?id=ED617654

Seifan, M., Robertson, N., & Berenjian, A. (2020). Use of virtual learning to increase key laboratory skills and essential non-cognitive characteristics. *Education for Chemical Engineers*, *33*, 66–75. https://doi.org/10.1016/j.ece.2020.07.006

Siedlecki, S. L. (2020). Quasi-Experimental research designs. *Clinical Nurse Specialist*, *34*(5), 198–202. https://doi.org/10.1097/nur.0000000000000540

Sullivan, S., Gnedilow, D., Puntambekar, S., Kim, J-S., (2017). Middle school students' learning of mechanics concepts through engagement in different sequences of physical and virtual experiments. *International Journal of Science Education*, 39(12), 1573–1600. https://doi.org/10.1080/09500693.2017.1341668

RESEARCH ARTICLE

SPORTS IMAGERY AND SPORTS CONFIDENCE AMONG FOOTBALL ATHLETES OF SAN JOSE FOOTBALL ACADEMY

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ABSTRACT

This study examined the relationship between sports imagery and sports confidence among football athletes of San Jose Football Academy in San Jose, Occidental Mindoro. A total of 90 athletes participated by answering validated questionnaires on their use of imagery and self-confidence levels. The findings showed that athletes who regularly practiced visualization techniques felt more confident in their performance. The findings revealed that athletes who engaged in effective visualization techniques reported higher confidence scores. Among the different types of imagery, concentration-focused imagery was found to be a strong predictor of sports confidence. This highlights the importance of mental preparation in boosting an athlete's self-belief. Based on these findings, the study recommends incorporating imagery training into the academy's athlete development programs. Doing so could help enhance player's confidence and overall performance. Additionally, future research should conduct longitudinal studies to assess the long-term effects of imagery practices on sports confidence in football athletes.

Keywords: concentration, football athletes, mental preparation, sports imagery, sports confidence

SDG: SDG 3: Good Health and Well-Being, SDG 4: Quality Education, SDG 11: Sustainable Cities and Communities

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INTRODUCTION

In recent years, sports imagery has become increasingly recognized as a powerful mental tool that helps athletes, especially football players, boost their performance and build confidence on and off the field. Research has demonstrated that imagery can yield emotional, cognitive, and behavioral benefits for athletes (Siekańska et al., 2021). Football, with its pace and demand for quick decisions under pressure, is the perfect sport to benefit from imagery techniques that help athletes sharpen their skills and stay focused. Studies like those of Trotter et al. (2021) emphasize that imagery is a critical psychological skill for athletes, aiding in skill enhancement and goal achievement. Players at the San Jose Football Academy have noticed that using sports imagery has helped them improve their performance and achieve their goals more successfully.

Despite these advancements, challenges remain. Negative mental imagery often carries more emotional weight than positive visualization, potentially hindering performance (Di Corrado et al., 2025). This highlights the need for strategies to counteract self-doubt and anxiety, which can impair athletic outcomes. While past studies have looked at how imagery and confidence each affect performance on their own, there's still limited research exploring how the two actually influence each other-how imagery can build confidence, and in turn, how confidence can make imagery more effective. This fragmented understanding restricts the development of integrated strategies to optimize training outcomes (Weinberg et al., 2018). In the Philippines, sports organizations like the Philippine Sports Commission have begun incorporating psychological skills training into athletic programs (Evangelista, 199). These initiatives underscore the increasing value placed on mental preparation in boosting athletic performance. Still, there's a gap in fully understanding how these elements work together, especially within a specific sport like football.

This study sets out to bridge the gap by exploring the connection between sports imagery and sports confidence among football athletes at the San Jose Football Academy. It looks how an athlete's confidence level, in turn, can affect how well imagery works to improve performance. By focusing on this two-way relationship, the study hopes to give coaches, athletes, and sports psychologists useful insights that can strengthen training programs and support both mental resilience and athletic growth.

METHODS

Research Design

The study utilized a descriptive-correlation survey design, employing a quantitative approach. This research design is well-suited for collecting data from population to understand the frequency of sports imagery and sports confidence. This study aimed to investigate the significant relationship between sports imagery and sports confidence of San Jose Football Academy Athletes.

Study Setting

The study was conducted at Occidental Mindoro Sports Complex, located in Bagong Silang, San Jose, Occidental Mindoro during the training season of San Jose Football Academy Athletes in preparation for Provincial Meet 2024.

Unit of Analysis and Sampling

The respondents of this study were the football athletes of San Jose Football Academy, with a total population of 116 athletes. A random sampling technique was utilized, and 90 respondents were randomly selected from this population. To determine the appropriate sample size, an online sample size calculator was used. This sample size was deemed sufficient to draw conclusion and test the hypothesis of the current study.

Research Instrument

The data were collected using questionnaires having two parts. The first part of the instrument is the Unified Mental Skills Assessment by Huyghe (2022), which is an adapted 30-item questionnaire that evaluates the frequency of sports imagery related to motivation, concentration, and mental preparation among football athletes. The athletes' responses were measured using a 5-point Likert scale, where the values correspond the following: (0.00 – 1.49 = Never, 1.50 – 2.49 = Rarely, 2.50 – 3.49 = Sometimes, 3.50 – 4.49 = Often, and 4.50 – 5.00 = Always).

The second part of the instrument is the Illinois Self Evaluation Questionnaire from Cox et al. (2023), which includes an adapted 15-item questionnaire designed to assess athletes perceived level of sports confidence. This section also utilized a 5-point Likert scale for responses, with the following categories: (0.00 – 1.49 = Very Low, 1.50 – 2.49 = Low, 2.50 – 3.49 = Moderate, 3.50 – 4.49 = High, and 4.50 – 5.00 = Very High).

Both parts of the instrument were modified from existing questionnaires to better suit specific context of this study. The instrument was submitted to three physical education research experts at Occidental Mindoro State College for content validation, and their suggestions and recommendations were incorporated into the final version of the instrument.

Data Collection Procedure

To collect accurate data, the researcher adhered to the following protocols to address ethical considerations in conducting the study.

Communication letter was sent to the President of San Jose Football Academy to obtain approval. Once approval was granted, the questionnaires were distributed to the respondents. They were given sufficient time to complete the questionnaires, ensuring that their responses were truthful and objective. After data collection, the responses were analyzed, tabulated, and interpreted.

Data Processing and Analysis

All responses were processed and analyzed using statistical software. The frequency of sports imagery and the level of sports confidence among respondents were assessed by calculating the mean. The relationship between the variables was examined using the Pearson

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Product-Moment Correlation Coefficient. Additionally, Multiple Regression Analysis was utilized to determined which factors best predict the level of sports confidence.

RESULTS

Frequency of sports imagery

Table 1 presents the frequency of sports imagery use among the members of the San Jose Football Academy. The survey focused on three aspects: Motivation, Concentration, and Mental Preparation. The overall frequency of using sports imagery among the respondents was interpreted as "Often," with a grand mean of 3.88 and a standard deviation of 0.44.

Table 1. Frequency of sports imagery among football athletes of San Jose Football Academy.

Sports Imagery Indicators	Mean	SD
Motivation	3.62	0.51
Concentration	4.02	0.55
Mental Preparation	4.01	0.61
GRAND MEAN	3.88	0.44

Legend: 0.00 – 1.49 (Never); 1.50 – 2.49 (Rarely); 2.50 – 3.49 (Sometimes); 3.50 – 4.49 (Often); 4.50 – 5.00 (Always)

Perceived level of sports confidence

Table 2. Perceived level of sports confidence among football athletes of San Jose Football Academy

Sports Confidence	Mean	SD
My confidence when I step onto the field before a game.	3.77	0.87
My confidence when I make mistakes during a game.	3.49	1.13
My confidence when I'm faced a challenging opponent before a game.	3.17	1.12
My confidence to overcome fears during a game.	3.66	1.14
My confidence to visualize successful outcomes when I see the opponents before a match or competition.	3.67	1.12
My confidence when I'm pressured during a game.	3.29	1.41
My confidence after a poor performance in a game.	3.13	1.01
My confidence when I know I can beat my opponent.	4.08	1.04
My confidence when I am physically ready before the game.	4.06	1.18
My confidence when I'm not the top performer on my team.	3.44	1.12
My confidence in training and preparation is sufficient to perform well in my sport.	3.70	1.16
My confidence after the feedback and criticism from my coach or teammates.	3.38	1.04
My confidence when I'm competing individually or as part of a team.	3.78	0.86
My confidence affects my enjoyment of the sport.	3.96	1.20
My confidence level changes when I meet the opponent before the course of a game or match.	3.64	1.06
GRAND MEAN	3.61	0.73

Legend: 0.00 – 1.49 (Very Low); 1.50 – 2.49 (Low); 2.50 – 3.49 (Moderate); 3.50 – 4.4 (High); 4.50 – 5.00 (Very High)

Table 2 presents the perceived level of sports confidence among the members of the San Jose Football Academy. With a grand mean of 3.61 and a standard deviation of 0.73, the respondents perceived confidence level is categorized as "High."

Relationship between sports imagery and sports confidence

The analysis presented in Table 3 shows that there is a significant moderate positive relationship ($r = 0.51$, $p < 0.05$) between the respondents' frequency of using sports imagery and their perceived level of sports confidence.

Table 3. Relationship between sports imagery and sports confidence among football athletes of San Jose Football Academy

Variables	Correlation Coefficient	p-value	Interpretation
Frequency of use of Sports Imagery Perceived Level of Sports Confidence	0.51	.001	Significant

Legend: p-value < 0.05 = Significant

Factors of sports imagery

As shown in Table 4, regression analysis identified that the concentration aspect of sports imagery significantly predicts sports confidence ($\beta = 0.604$, $p < 0.05$). Motivation and mental preparation did not have significant predictive value.

Table 4. Factors of sports imagery best predicts the level of sports confidence.

Variables	Beta	SE	t	P	%CI
Motivation	-.067	.091	-.734	.465	[-.352, .162]
Concentration	.604	.111	5.448	.001	[-.505, 1.085]
Mental Preparation	.052	.107	.481	.632	[-.191, .313]

Legend: p-value < 0.05 = Significant

DISCUSSION

The findings of this study emphasize the critical role of sports imagery in enhancing motivation, concentration, and mental preparation among athletes of San Jose Football Academy. Athletes frequently use imagery for motivation, with encouragement from teammates being a significant source of energy, while visualizing opponent's physical appearance is less effective. Concentration- focused imagery is particularly valuable when facing tough opponents, reflecting mental discipline, through external distractions remain a challenge. Concentrated imagery is imported in improving performance and psychological being (Budnik-Przybylska et al., 2023. Mental preparation through imagery also aids athletes in planning communication strategies during gameplay, supporting decision-making and stress management as highlighted by Behnke et al. (2017). However, occasional overthinking of minor details does not significantly hinder performance.

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The study further reveals a strong positive correlation between frequent sports imagery use and higher confidence levels. Athletes who visualize successful outcomes exhibit greater self-assurance even under pressure, a finding supported by Gould and Maynard (2009) and Weinberg and Gould (2015), who emphasize the importance of visualization and pre-game routines in building focus and emotional control. Concentration-focused imagery emerges as the strongest predictor of sports confidence, surpassing motivation and mental preparation. This aligns with Gagnon-Dolbec, A. (2015), who highlight the role of focused attention in minimizing distractions and boosting confidence.

Despite these benefits, limitations include the variability in athletes' confidence after setbacks or poor performances, suggesting a need for interventions to build resilience. Further research could explore tailored psychological training programs that emphasize concentration imagery while addressing confidence recovery strategies. Practical applications include integrating structured imagery techniques into training regimens to enhance both mental resilience and athlete performance. Extensions of this study could investigate the impact of guided imagery interventions across different sports or demographic groups to further refine psychological skills training methods.

CONCLUSION

This study draws several key conclusions based on its findings, Firstly, the regular utilization of sports imagery by athletes at the San Jose Football Academy underscores the importance of mental preparation in enhancing athletic performance. Additionally, a strong correlation exists between physical preparedness, mental visualization techniques, and high sports confidence among athletes. The study also reveals that the regular use of sports imagery is positively associated with athlete's confidence levels, suggesting its potential integration into self-confidence development programs. Furthermore, concentration imagery is found to significantly enhance confidence, highlighting the critical role of mental focus in achieving success in sports.

Based on the study's findings and conclusions, several recommendations are proposed. Coaches are advised to implement various sports psychology strategies to boost athletes' confidence, including consistent positive reinforcement, realistic goal-setting, visualization techniques, trust-building communication, mindfulness, and emotional regulation, as well as resilience training. Moreover, coaches are encouraged to promote the use of sports imagery among football athletes to enhance performance, given its widespread adoption before and during games. By visualizing key skills and game scenarios in detail, athletes can improve their technique and decision-making. Conducting sports clinics before events can also help strengthen athletes' skills and overall performance. Lastly, future researchers are suggested to explore the impact of self-belief, objective focus, and emotional awareness on athletes' self-assurance, providing a more comprehensive understanding of the psychological factors influencing mental visualization and athletic performance.

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REFERENCES

Behnke, M., Tomczak, M., Kaczmarek, L. D., Komar, M., & Gracz, J. (2017). The Sport Mental Training Questionnaire: Development and Validation. *Current Psychology, 38(2), 504–516.* https://doi.org/10.1007/s12144-017-9629-1

Budnik-Przybylska, D., Syty, P., Kaźmierczak, M., Łabuda, M., Doliński, Ł., Kastrau, A., Jasik, P., Przybylski, J., Di Fronso, S., & Bertollo, M. (2023). Exploring the influence of personal factors on physiological responses to mental imagery in sport. *Scientific Reports*, *13*(1). https://doi.org/10.1038/s41598-023-29811-6

Cox, R. H., Martens, M. P., & Russell, W. D. (2003). Measuring Anxiety in Athletics: The Revised Competitive State Anxiety Inventory–2. *Journal of Sport and Exercise Psychology, 25(4), 519–533.* https://doi.org/10.1123/jsep.25.4.519

Di Corrado, D., Tortella, P., Coco, M., Guarnera, M., Tusak, M., & Parisi, M. C. (2025). Mental imagery and stress: the mediating role of self-efficacy in competitive martial arts athletes. *Frontiers in Psychology*, *16*. https://doi.org/10.3389/fpsyg.2025.1517718

Evangelista, R. M. L. (1999). The status of psychological skills training delivered at the Philippine sports commission. *Animo Repository*. https://animorepository.dlsu.edu.ph/etd_bachelors/1685/

Gagnon-Dolbec, A. (2015). The role of focus and confidence in high-level athletic performances. *uOttawa*. https://doi.org/10.20381/ruor-4339

Gould, D., & Maynard, I. (2009). Psychological preparation for the Olympic Games. *Journal of Sports Sciences*, *27*(13), 1393–1408. https://doi.org/10.1080/02640410903081845

Huyghe, L. (2022). Development of the UMSAT6: A self-questionnaire on mental skills. *Institut Neuro Sport*. https://institutneurosport.com/questionnaire- umsat6-us.html

Siekańska, M., Bondár, R. Z., Di Fronso, S., Blecharz, J., & Bertollo, M. (2021). Integrating technology in psychological skills training for performance optimization in elite athletes: A systematic review. *Psychology of Sport and Exercise*, *57*, 102008. https://doi.org/10.1016/j.psychsport.2021.102008

Trotter, M. G., Coulter, T. J., Davis, P. A., Poulus, D. R., & Polman, R. (2021). Social support, self-regulation, and psychological skill use in e-athletes. *Frontiers in psychology, 12, 722030.* https://doi.org/10.3389/fpsyg.2021.722030.

Weinberg, R. S., & Gould, D. (2015). Foundations of Sport and Exercise Psychology (6th ed.). *Champaign, IL: Human Kinetics.*

Weinberg, R. S., & Gould, D. (2018). Foundations of sport and exercise psychology (7th ed.). *Champaign, IL: Human Kinetics.*

RESEARCH ARTICLE

ERGONOMIC RISK ASSESSMENT AND SAFETY ENHANCEMENTS TOWARD SUSTAINABLE RICE MILLING OPERATION

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ABSTRACT

This study investigates the physical, cognitive, and environmental demands in the rice milling industry in Occidental Mindoro. The assessment involved a sample of 30 employees across various roles, including classifiers, dispatchers, baggers, bran porters, porters, and machine operators. The study incorporated an integration of ergonomic tools, including the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), Ovako Working-Posture Analysis System (OWAS), Rapid Entire Body Assessment (REBA), and NIOSH Lifting Equation for physical-based analysis. CarMenQ and the NASA-TLX, to assess the workload and cognitive strain. The results indicated that bran porters and porters are often exposed to risks of MSDs due to the nature of work. On the other hand, baggers, dispatchers, and rice mill machine operators experienced the highest levels of cognitive workload. Findings also indicated that musculoskeletal disorders (MSDs) are significant contributors to absenteeism, with 86.76% of workers reporting such conditions. Environmental factors, such as excessive noise and humidity, have a further impact on the challenges faced by workers in the bagging and operating areas. The study focused on the implementation of systematic job rotation and the redesign of job descriptions, and recommended ergonomic measures to improve the workplace environment, with the aim to reduce the absenteeism of employees and enhanced the overall worker well-being and operational efficiency in the rice milling sector.

Keywords*: health, ergonomics, occupational safety, rice milling industry, workers' efficiency and productivity*

SDG: *SDG 3: Good health and well-being, SDG 8: Decent work and economic growth*

INTRODUCTION

Rice production is an essential part of food security in Asia, as it has served as a staple food over the last 7,000 years for more than 3.5 billion people in agricultural countries, including the Philippines (Amanullah & Shah Fahad, 2017). Mindoro leads the MIMAROPA region in rice production, contributing 6% of the Philippines' total rice output, with the municipality of San Jose as the top producer (Philippine Rice Research Institute - Data Analytics Center, 2023).

However, despite its crucial role, the rice milling industry often disregards ergonomics and worker safety. Rice mill workers face heavy manual material handling tasks such as lifting, pulling, and carrying loads, increasing their risk of back pain, fractures, and fatigue (Astuti et al., 2017), which is referred to as musculoskeletal disorders (MSDs) (Ojukwu et al., 2017), which significantly impacts workers mobility, well-being, and workforce productivity (World Health Organization, 2022). Moreover, workers in rice mill industries are also facing cognitive and environmental risks. As manufacturing becomes more complex due to technology and innovation, the mental challenges correspond with high mental workloads, leading to tiredness, lack of focus, and increased errors (Reiman et al., 2021). Rice milling operations can be especially hazardous, with noise levels during steaming reaching as high as 88.5 dBA, resulting in hearing impairment and cognitive fatigue (Occupational Safety and Health Administration, 2002).

Ergonomics prevents workplace injuries and improves the overall productivity of workers by minimizing physical, cognitive, and environmental stressors (Mehta, 2016). Physical ergonomics deals with posture, muscle strain, and work-related MSDs (Mehta, 2016). Cognitive ergonomics studies the mental workload, stress, and decision-making processes, and it designs systems to aid in the optimization of human task performance while reducing strain from cognitive factors (Shiddiqy et al., 2023). However, environmental ergonomics has demonstrated that environmental factors like light, temperature, and sound affect environmental perception, cognitive performance, and stress (Rezvanizadeh et al., 2023). Ergonomics not only safeguards workers' health and safety but also boosts productivity and reduces the potential costs and waste (Silva et al., 2024).

However, past ergonomics-related studies within the rice milling industry were primarily focused on physical ergonomics, assessing postures, muscle exertion, and musculoskeletal disorders (MSDs) risk (Maulana Rosyidi et al., 2023; Rafiee et al., 2023). However, studies on how cognitive and environmental factors contribute to the workplace stressors experienced by workers are lacking. Thus, this study addresses the gap by integrating physical, cognitive, and environmental ergonomics. This paper intends to provide a more comprehensive ergonomic risk assessment in rice milling operations.

In conclusion, the primary objectives of the study were to identify workers in the rice milling section who are at risk of physical or cognitive strain, or both, and include environmental assessments to recommend strategies for enhancing occupational safety, health, and well-being through the application of various industrial engineering principles and methods.

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METHODS

The researchers conducted the study on one of the prominent rice mill corporations located in San Jose, Occidental Mindoro, Philippines. A total of 30 workers in the rice milling facility were involved in the study, including 3 classifiers, 3 dispatchers, 2 forklift operators, 2 baggers, 2 rice mill machine operators, 2 bran porters, and 16 porters. The researchers have conducted a review of related literature, direct observations, surveys, interviews, and actual data gathering to identify occupational risk factors in physical, cognitive, and environmental ergonomics. The CMDQ, OWAS, REBA, and NIOSH Lifting equations are intended for postural and biomechanics-based analysis. On the other hand, CarmenQ and NASA-TLX are utilized to explore and investigate different dimensions of mental workload. Moreover, temperature and humidity indicators, as well as NIOSH sound meter levels, are tools used in the study to assess environmental factors. After identifying the workers who required ergonomic interventions, the researchers proposed targeted solutions aimed at improving working conditions and addressing the challenges faced by the employees. These proposed interventions were presented to the company's stakeholders through a Focus Group Discussion (FGD) to assess their feasibility and alignment with company policies. Upon approval, the ergonomic interventions were implemented over a one-month period to observe their effectiveness and efficiency in improving worker well-being and productivity

Statistical Analysis

Quantitative measures were used to analyze occupational risk factors obtained from the data gathering. This allowed the researchers to create the analysis and derive the relevant implications and conclusions in a non-biased manner. Statistical methods are employed to verify data with a normality test, to identify significant relationships among observed independent and dependent variables with regression analysis, and to reveal workers with high ergonomic risks with a one-way ANOVA Tukey post-hoc test.

RESULTS

Assessments are conducted using various tools to evaluate workers' physical and cognitive demands in the rice milling section of a leading rice milling industry in San Jose, Occidental Mindoro. The study includes a sample of 30 workers who report daily, each performing distinct roles within the corporation.

Physical Ergonomic Assessment

The following analysis includes CMDQ, OWAS, REBA, and NIOSH Lifting Equation. These tools are used to observe how various postures and movements may contribute to the potential risk of developing musculoskeletal disorders.

Table 1 above summarizes factors experienced by rice mill workers gathered from the researchers' survey. Overall, MSDs were widely experienced by the participants, with 86.76 %, while 26.67 % of the workers reported that workload and fatigue brought about by the nature of their work resulted in their absence. The factors were then followed by personal reason (23.33%) and Poor Working Conditions (6.67 %).

Table 1. Summary of Absenteeism Factors Among Rice Mill Workers

ABSENTEEISM FACTORS		
Factor	Percentage	Rank
Musculoskeletal Disorders (MSDs)	86.76 %	1
Poor Working Conditions	6.67 %	4
Workload and Fatigue	26.67 %	2
Personal Reason	23.33 %	3

Cornell Musculoskeletal Discomfort Questionnaire (CMDQ) Result

The results below are based on the researchers' face-to-face survey using a printed questionnaire of the CMDQ distributed to the workers of rice milling areas.

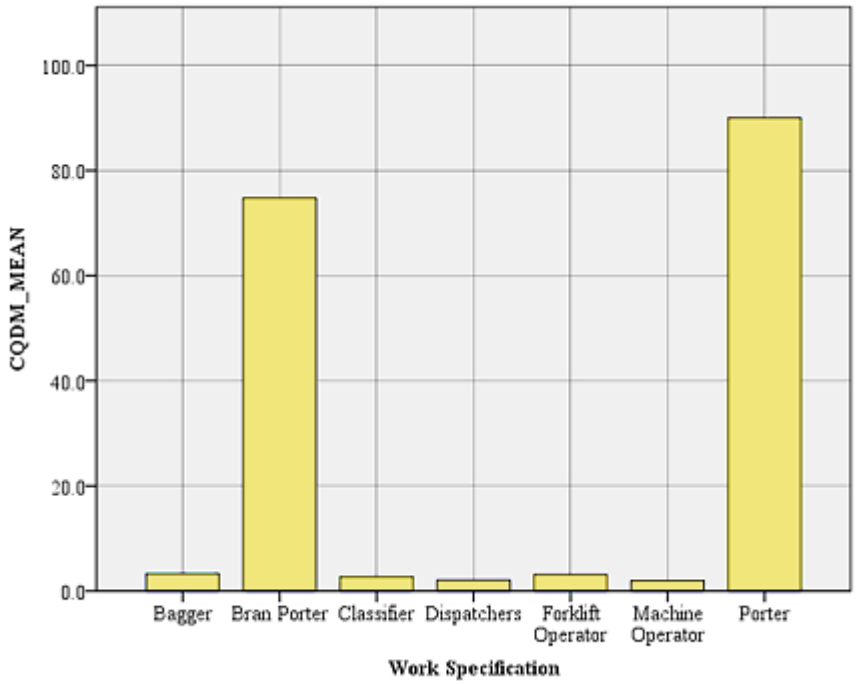

Fig. 1. Summary Report of Discomfort Scores by Work Specification.

According to the researchers' survey, bran porters and porters are the most affected, with a significant number reporting that these workers experience severe discomfort due to the physically intensive nature of their tasks, as shown in Fig. 1

Normality Test

Table 2 demonstrates that all measured physical dimensions follow a normal distribution, indicated by a p-value of less than 0.05. This suggests a 95% confidence level in the results.

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Table 2. Normality Test Results

Dimension	Mean	Standard Deviation	p-value	Interpretation
OWAS	2.294	1.051	<0.005	Normal
REBA	8.142	3.386	0.023	Normal
CarMen-Q	2.090	0.388	<0.005	Normal
NASA-TLX	3.289	0.637	<0.005	Normal

Ovako Working-Posture Analysis System (OWAS) Regression Analysis

Table 3 presents the regression analysis of OWAS and REBA. It was identified that in OWAS, workers' sex, height, weight, and work specifications have a positive correlation with their risk levels, with a significant level of less than 0.05. However, REBA validates the OWAS result, except for weight, which was found to be not statistically significant with a p-value of 0.187.

Table 3. Summary of Results in OWAS and REBA.

Independent Variable	Dependent Variable	p-value	Interpretation	Dependent Variable	p-value	Interpretation
Age	OWAS Score	0.375	Not Significant	REBA Score	0.717	Not Significant
Sex	OWAS Score	0.005	Significant	REBA Score	0.000	Significant
Height	OWAS Score	0.013	Significant	REBA Score	0.003	Significant
Weight	OWAS Score	0.034	Significant	REBA Score	0.187	Not Significant
Work Specification	OWAS Score	0.000	Significant	REBA Score	0.000	Significant

One-Way ANOVA – Tukey Post-Hoc Test for OWAS

Table 4 presents the assessment of workers' demographic profiles and OWAS scores. The analysis revealed that the OWAS score does not have a statistically significant impact on age and weight, emphasizing that these factors may not directly affect postural risk levels experienced by workers during the task execution. Moreover, sex, height, and work specifications demonstrate a significant correlation to OWAS score, highlighting that male bran porters and porters with a height of 5'1 to 5'5 ft often experience postural-related risks, due to the various assigned tasks, muscle strength, and anthropometric differences.

Table 4. Workers' demographic profile vs. OWAS score.

Independent	Dependent	Highest Mean	Lowest Mean	Statistical Grouping	Interpretation
Age	OWAS Score	41 to 45 years old	46 to 50 years old	A	Not statistically significant
Sex	Owas Score	Male	Female	A and B	Statistically significant
Height	OWAS Score	5'1 to 5'5 ft	4'6 to 5'0 ft	A and B	Statistically significant
Weight	OWAS Score	51 to 55 kg	36 to 40 kg	A	Not statistically significant
Work Specification	OWAS Score	Bran porters and porters	Machine operators, Baggers, Forklift operators, and Dispatchers	A and B	Statistically significant

Grouping Information Using the Tukey Method and 95% Confidence

OWAS Initial Assessment

Analysis depicts a detailed analysis of various work specifications through OWAS. The interval plot illustrates the average OWAS (Ovako Working Posture Analysis System) scores for various work specifications, along with 95% confidence intervals. According to Fig. 2, the work specifications 6 (bran porters) and 7 (porters) have OWAS mean scores of 3, which suggests that their working postures have harmful effects on the musculoskeletal system, requiring corrective actions as soon as possible. This highlights that Bran Porters and Porters are identified as having the highest ergonomic risks, indicating the urgent interventions to reduce physical strain in these job roles.

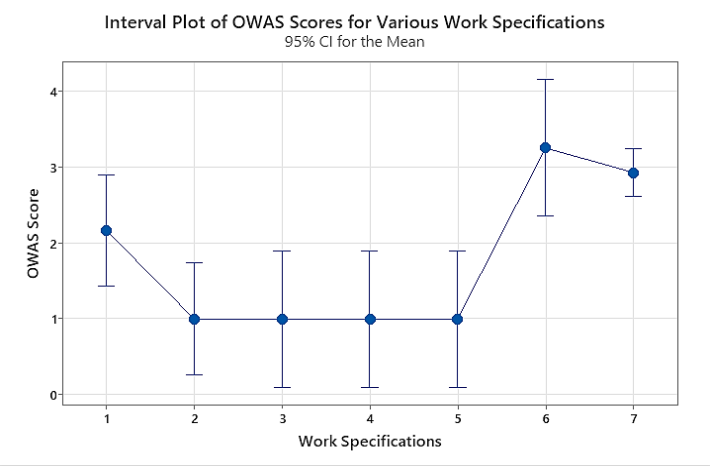

Fig. 2. OWAS Score vs. Work Specifications.

Rapid Entire Body Assessment (REBA)

This study utilized a computer-aided design system (CAD) to define different measurements that are significant for the success of the analysis.

One Way ANOVA – Tukey Post-Hoc Test

Table 5 indicates the Tukey HSD analysis in workers' demographic profiles and REBA score. The assessment identified that the REBA score does not have a significant correlation with age and weight, demonstrating that these are not major factors that lead to the development of musculoskeletal disorders. Furthermore, sex and height are positively correlated to REBA score, emphasizing that male porters and bran porters with a height of 5'6 to 6'0 ft possess higher ergonomic risks, due to the various anthropometric differences and capabilities, the same to OWAS findings.

Table 5. Workers' demographic profiles vs. REBA Score

Independent	Dependent	Highest Mean	Lowest Mean	Statistical Grouping	Interpretation
Age	REBA Score	16 to 20 years old	56 to 60 years old	A	Not statistically significant
Sex	REBA Score	Male	Female	A and B	Statistically significant
Height	REBA Score	5'6 to 6'0 ft	4'6 to 5'0 ft	A and B	Statistically significant
Weight	REBA Score	46 to 50 kg	36 to 40 kg	A	Not statistically significant
Work Specification	REBA Score	Porters and Bran porters	Machine operators and Dispatchers	A, B, and C	Statistically significant

Grouping Information Using the Tukey Method and 95% Confidence

REBA Initial Result

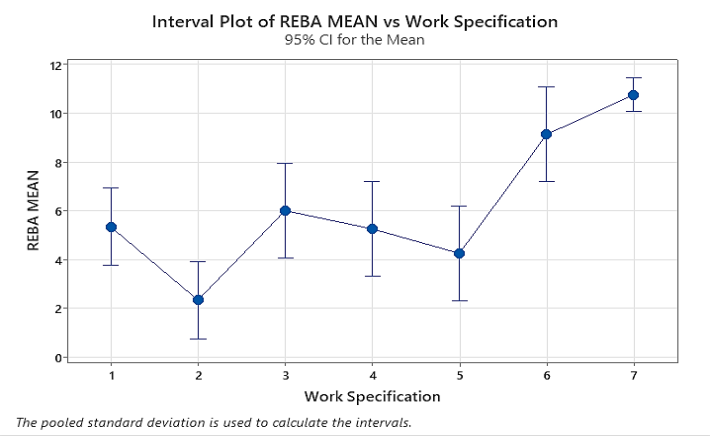

Fig. 3. REBA Initial Result.

The Tukey HSD analysis identifies that male workers with a height range of 5'1" to 6'0" in the work specifications of work specification 7 (porters) and 6 (bran porters) as the primary target for physical ergonomic interventions, with a mean value of 9 and 10, as illustrated in Fig. 3, indicating high risk, investigate and implement change.

NIOSH Lifting Equation

Researchers also evaluated the biomechanics of bran porters and porters through the NIOSH Lifting Equation. Moreover, the researchers utilized lifting index (LI) to identify the level of risk associated with the biomechanics of the workers: ≤1.00 = very low risk, 1.01 – 1.50 = low risk, 1.51 – 2.00 = moderate risk, 2.01 – 3.00 = high risk, and more than 3.00 = very high risk.

The current work movement showed a poor job of lifting posture in both tasks since the actual load is greater than the recommended weight limit, as seen in the result of the NIOSH lifting equation in Table 6

Table 6. Summary of NIOSH scores for Bran porters

Task		HM	VM	AM	DM	CM	FM	RWL	Load	LI
Lifting the sack	Origin	1	0.86	1	0.98	0.9	0.85	14.83 kg	88 lbs	**5.93**
Transporting it into the specified location	Destination	1	0.86	1	0.94	0.9	0.85	14.22 kg	88 lbs	**6.19**
Lifting the sack	Origin	1	0.8	1	0.9	0.9	0.75	11.18kg	88lbs	**7.87**
Transporting it into the specified location	Destination	1	0.95	0.91	0.9	0.9	0.75	12.08kg	88lbs	**7.28**

Legend: HM = Horizontal multiplier factor, VM = Vertical multiplier factor, AM = Asymmetric multiplier factor, DM = Distance multiplier factor, CM = Coupling multiplier factor, RWL = Recommended weight limit, LI = Lifting index.

The current work movement showed a poor job of lifting posture in both tasks since the actual load of the origin (5.93 & 7.87) and destination (LI = 6.19 & 7.28) is greater than the lifting index of 1.01-1.50 (Gi, 2006), as seen in the result of the NIOSH lifting equation in Table 6.

The current lifting posture is risky with LI of greater than 1.00 (Centers for Disease Control and Prevention, 2024). Thus, it was identified that all 16 porters experience high risk with a lifting index value ranging from 5.08 to 20.99, higher than the acceptable threshold

Cognitive Assessment

CarMen-Q using Regression Analysis

Carmen – Q investigates the four mental workload dimensions, such as cognitive, temporal, emotional/health, and performance demand of the workers.

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Table 8 presents a summary of the results in CarMen-Q using regression analysis. The table reveals significant correlations between various factors and cognitive workload dimensions, with a p-value of less than 0.05, such as sex, height, weight, and work specification.

Table 8. Summary of Results in CarMen-Q using Regression Analysis.

Independent	Dependent	R - squared	p-value	Interpretation
Sex	Temporal Demand	46.50%	0.000	Significant
Sex	Performance Demand	35.34%	0.001	Significant
Height	Temporal Demand	27.33%	0.013	Significant
Weight	Cognitive Demand	46.61%	0.033	Significant
Weight	Total mental workload	53.38%	0.009	Significant
Work Specification	Cognitive Demand	94.82%	0.000	Significant
Work Specification	Emotional Demand	70.77%	0.000	Significant
Work Specification	Temporal Demand	82.56%	0.000	Significant
Work Specification	Performance Demand	99.03%	0.000	Significant
Work Specification	Total mental workload	93.34%	0.000	Significant

CARMENQ Initial Result using One Way ANOVA – Tukey Post-Hoc Test

Table 9 presents the results of the Tukey HSD test for overall cognitive workload across different work specifications, considering the four dimensions of the Carmen Questionnaire (CQ): cognitive, emotional, temporal, and performance demand. The analysis reveals a statistically significant difference in overall workload demand based on job responsibilities, duties, and the nature of work. The results indicate that baggers and rice mill machine operators experience the highest overall cognitive workload, with mean scores of 2.946 and 2.9304, respectively, placing them in Group A. These values approach a mean score of 3 (often), suggesting frequent exposure to cognitive strain. Followed by dispatchers (B), bran porters (BC), porters (C), forklift operators (CD), and classifiers (D).

Table 9. One Way ANOVA – Tukey Post-Hoc Test of Overall Workload Demand (CQ) vs. Work Specification.

Work Specification	N	Mean	Grouping			
Baggers	2	2.946	A			
Machine Operators	2	2.9304	A			
Dispatchers	3	2.3333		B		
Bran porters	2	2.1643		B	C	
Porters	16	1.9237			C	
Forklift Operators	2	1.871			C	D
Classifiers	3	1.6952				D

Grouping Information Using the Tukey Method and 95% Confidence

National Aeronautics Space Administration Task Load Index (NASA-TLX)

Workers with different work classifications are asked to assign a weight to each sub-scale from their perspective, which is informed by their job specification. This study used Likert-type scales with numerical values such as (1 = low (0 – 9), 2 = medium (10 – 29), 3 = somewhat high (30 – 49), 4 = high (50 – 79), and 5 = very high (80 – 100)) to measure the cognitive demand of the workers.

NASA-TLX using Regression Analysis

Table 10. Summary of Results in NASA-TLX.

Independent Variable	Dependent Variable	R-squared	p-value
Age	Physical Demand	53.99%	0.009
Height	NASA TLX Score	32.27%	0.005
Height	Mental Demand	21.25%	0.040
Height	Temporal Demand	21.87%	0.036
Height	Effort Demand	39.38%	0.001
Height	Frustration Level	23.34%	0.028
Work Specification	NASA TLX Score	83.30%	0.000
Work Specification	Mental Demand	41.63%	0.037
Work Specification	Physical Demand	85.06%	0.000
Work Specification	Temporal Demand	84.56%	0.000
Work Specification	Effort Demand	85.18%	0.000
Work Specification	Frustration Level	74.90%	0.000
Work Specification	Performance Level	44.44%	0.024

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Regression analysis in Table 10 identifies a causal correlation of the observed variables. It was revealed through analysis that age, height, and work specification have a positive correlation with NASA-TLX dimensions and score, with a p-value of less than 0.05.

NASA-TLX using One Way ANOVA – Tukey Post-Hoc Test

Table 11 presents the results of a One-Way ANOVA with a Tukey post-hoc test, analyzing NASA-TLX scores across different work roles. The findings reveal significant differences in overall workload perception among various roles. Dispatchers and machine operators exhibit the highest NASA-TLX scores, with mean values of 4.556 (very high) and 4.333 (high), respectively, placing them in statistical Group A. Forklift operators, porters, classifiers, bran porters, and baggers fall into statistical Group B, with mean scores ranging from 3.333 to 2.500, which is categorized in more manageable workload demand. Overall, the results highlight the necessity of targeted ergonomic improvements for dispatchers and machine operators to enhance worker well-being and overall efficiency

Table 11. One-way ANOVA: NASA-TLX Scores versus Work Specification.

Work Specification	N	Mean	Grouping	
Dispatchers	3	4.556	A	
Machine operators	2	4.333	A	
Forklift operators	2	3.333		B
Porters	16	3.1771		B
Classifiers	3	2.778		B
Bran porters	2	2.750		B
Baggers	2	2.500		B

Grouping Information Using the Tukey Method and 95% Confidence

Assessment of Work Environment Design of Rice Mills

To evaluate the physical environment of the rice mill, the researchers initially measured the noise level, humidity level, and temperature.

Table 12 shows the 30 daily measurements of some work environment factors in some rice mill areas to assess noise levels (dBA), humidity (%), and temperature (°C) for morning and afternoon shifts. The data show that the noise level is high in the operating area and bagging area; levels are recorded in the morning at 88.8 and 86.8 dBA and in the afternoon at 89.1, and 87.0 dBA, respectively, which is above the occupational exposure limit recommended by the Occupational Safety and Health Administration (OSHA, 2002) of 85 dBA. This means there may be a risk for long-term hearing damage unless an adequate level of hearing protection is used; thus, noise control measures need to be implemented. Humidity ranges from 53% to 64% and increases during the afternoon in the bran (64%) and dispatch (62%) areas. Humidity is also an important factor for thermal comfort and can lead to heat stress when coupled with increased temperatures (Moradpour et al., 2024). Temperatures were recorded between 32.1°C and 34.2°C,

with high values recorded in the afternoon (34.2°C in the operating area and 34.0°C in the bran area). These temperatures exceed the ideal comfort zone for workers, which is 19 to 26°C (Gumasing & Lustañas, 2021).

Table 12. Measurement of Work Environment.

PHYSICAL ENVIRONMENT FACTORS							
Physical Factor	Time	Loading/ Unloading Area	Dragger Area	Bagging Area	Operating Area	Bran Area	Dispatch Area
Noise level (dbA)	Morning	71.0	74.0	86.8	88.8	79.2	71.1
	Afternoon	72.5	75.5	87.0	89.1	80.2	72.3
Humidity (%)	Morning	57	54	55	53	56	56
	Afternoon	60	58	59	57	64	64
Temperature (°C)	Morning	32.7	32.5	32.1	32.7	32.7	32.4
	Afternoon	34.0	33.8	33.5	34.2	34.0	33.5

The study focused on assessing the ergonomic risk experienced by the workers in the rice milling industry. Based on the analysis, One-way ANOVA Tukey Post-hoc Test identified that bran porters and porters are prone to musculoskeletal disorders due to manual material handling and repetitive tasks. Dispatchers, baggers, and rice mill machine operators were determined to be usually facing cognitive challenges from multitasking, operating complex machinery, and maintaining focus in a fast-paced environment.

With a basis in ergonomic principles, the researchers presented proposed interventions to the company's stakeholders through a focus group discussion. The Focus Group Discussion (FGD) was conducted to verify and assess the feasibility of the proposed interventions. Following the discussion and necessary adjustments to the company's rules and regulations, the finalized interventions were approved and discussed below

Physical Ergonomic Intervention

Bran porters are the workers responsible for handling and lifting sacks of bran in the Bran area, a byproduct of rice milling. Their tasks include loading sacks into weighing scales, sewing, and stacking them onto pallets for storage. Rotating workers across tasks requiring varying levels of physical demand can mitigate work-related MSDs and improve their overall productivity (Shiddiqy et al., 2023).

Proposed Ergonomic Intervention

The researchers proposed job rotation to mitigate the development of MSDs among the bran porters and the porters.

Table 13 presents an 8-hour job rotation schedule for two Bran Porters, alternating between lifting sacks to the weighing scale and stacking sacks on pallets every two hours (Padula et al, 2016; The National Institute for Occupational Safety and Health (NIOSH), 2007).

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Table 13. Job Rotation Design for Bran Area.

Time Slot	Bran Porter 1	Bran Porter 2
0 – 2 hrs	Lift sacks to the weighing scale	Stack sacks on pallets
2 – 4 hrs	Stack sacks on pallets	Lift sacks to the weighing scale
4 – 6 hrs	Lift sacks to the weighing scale	Stack sacks on pallets
6 – 8 hrs	Stack sacks on pallets	Lift sacks to the weighing scale

Job Rotation Schedule

Porters in the rice mill facility assigned to dispatch, bagging, and dragger areas lift sacks of rice or palay onto delivery trucks, customer vehicles, stacking pallets, and/or designated locations. Porters are located in four different work areas with corresponding numbers of porters assigned, such as storage (6), dragger (6), dispatch (2), and bagging (2), with a total of 16 porters in the entire facility of the rice mill.

Table 14 shows that the job rotation plan has been created to mitigate worker fatigue, prevent injuries, and promote equitable workload distribution among the 16 porters (P) at the rice mill. During their shifts, these porters are responsible for handling heavy sacks of rice, weighing between 5 kg and 50 kg. To address this, a system will be implemented where porters rotate between various tasks every 2 hours. By rotating tasks, porters experience less fatigue, fewer injuries, and improved efficiency. Thus, this system benefits workers' well-being and milling operations by ensuring a fair and effective work environment

Table 14. Job Rotation Schedule.

Time slot	Storage Porters (6)	Dragger Porters (6)	Dispatch Porters (2)	Bagging Porters (2)
0 – 2 hrs	P3, P4, P5, P6, P13, P14	P7, P8, P11, P12, P15, P16	P1, P2	P9, P10
2 – 4 hrs	P7, P8, P9, P10, P15, P16	P1, P2, P5, P6, P13, P14	P3, P4	P11, P12
4 – 6 hrs	P1, P2, P3, P4, P11, P12	P7, P8, P9, P10, P15, P16	P5, P6	P13, P14
6 – 8 hrs	P5, P6, P9, P10, P13, P14	P1, P2, P3, P4, P11, P12	P7, P8	P15, P16

Cognitive Ergonomic Intervention

At the research site, there are three female dispatchers responsible for managing the distribution and inventory of rice sacks based on customer orders.

Proposed Ergonomic Intervention

Since different dispatcher roles involve varying levels of difficulty, job rotation was proposed by the researchers to help balance cognitive stress by alternating between tasks with different cognitive and physical demands, reducing fatigue and improving overall performance. A study conducted by (Mlekus & Maier, 2021), a job rotation schedule with an interval of 2 hours. This interval was a consensus between studies (de Oliveira Sato & Cote Gil

Coury, 2009), and is compatible with the premise of lactic acid reduction, which is connected to the muscle soreness and fatigue due to intensive workload demand.

During the Focus Group Discussion (FGD), stakeholders emphasized that frequent task *bala*, as shown in Table 15.

Table 15. Proposed Job Rotation Schedule.

Time	Small Scale Dispatcher	Large Scale Dispatcher	Inventory Management Dispatcher
Day 1	D1	D2	D3
Day 2	D3	D1	D2
Day 3	D2	D3	D1
Day 4	D1	D2	D3

Proposed Ergonomic Intervention

At the research site, two baggers operate tank machines for daily operations–one handling 5 kg portions and the other managing 25 kg portions.

As shown in Table 16, baggers will begin their shift in their original work positions and rotate every two hours, resulting in four rotations within an eight-hour work period, according to the recommendations of the Occupational Safety and Health Organization.

Table 16. Proposed Job Rotation Schedule

Time	5kg Bagger	25kg Bagger
0 – 2 hrs	B1	B2
2 – 4 hrs	B2	B1
4 – 6 hrs	B1	B2
6 – 8 hrs	B2	B1

Work Specification Definition

At the research site, operators are classified into two roles: the head machine operator and the assistant operator. The head operator is typically stationed on the 2nd floor of the rice milling facility, where the main control system for all machines is located. Their primary responsibility is to oversee and regulate the entire milling process from a central control point. Meanwhile, the assistant operator is positioned on the 1st floor to provide support and ensure smooth execution of the milling process by handling tasks that require on-site adjustments and maintenance.

Proposed Ergonomic Intervention

Job Description Design

The current division of duties between the head operator and the assistant operator reflects a significant imbalance in the distribution of responsibilities, leading to an uneven workload. While both the head and assistant operator are capable of performing basic tasks,

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certain key responsibilities are designated solely for the head operator. These include calculating batch milling and evaluating worker performance according to company regulations.

Table 17. Proposed job description

Head Operator	Assistant Operator
Operating machines and managing the system in the control room (1st and 2nd floor).	Substitute the head operator to operate all operations if not available.
Starting the machines and configuring measurement settings on the 2nd floor	Starting the machines and configuring measurement settings on the 1st floor
Monitoring production flow to ensure efficiency on the 2nd floor.	Monitoring machines' operation effectiveness to ensure efficiency on the 1st floor
Monitoring machines' operation effectiveness to ensure efficiency on the 2nd floor	Monitoring production flow to ensure efficiency on the 1st floor.
Inspecting product quality to maintain standards (2nd floor).	Inspecting product quality to maintain standards (1st floor).
Cleaning the rice milling area on the 2nd floor	Cleaning the rice milling area on the 1st floor
Calculating the batch milling.	Help the forklift operators in organizing the products
Evaluating workers' performance under the supervision of the head operator.	Collecting product samples for assessment and analysis.

To address this imbalance and reduce cognitive stress and strain on both operators, the researchers have proposed a revised job description that aims to reallocate duties and responsibilities systematically. The proposed job description is presented in Table 17.

The management approved and implemented a one-month intervention for the identified workers who needed ergonomic intervention. The implementation duration was supported by existing ergonomic-related studies. After one month of monitoring and implementation, the researchers conducted a post-test survey using CMDQ for physical assessment, and CarmenQ and NASA-TLX for cognitive assessment to evaluate the impact of the proposed intervention. The researchers utilized a statistical tool called the two-sample t-test to determine whether there is a significant difference between the current work setup and after the ergonomic intervention. The evaluation is presented below.

Intervention Assessment

Physical Intervention – Bran Porters and Porters

Table 18 presents the t-test result demonstrates that the observed difference is statistically significant, as it satisfies the significance threshold ($p<0.05$). These values provide strong evidence to reject the null hypothesis, confirming that the researchers' proposed intervention was effective in significantly reducing the risk of musculoskeletal disorders

Table 18. Paired Sample Test.

	Mean	Std. Deviation	Std. Error Mean	T-value	Degrees of Freedom (n – 1)	P-value (2-paired)
CMDQ Mean Pre-test and Post-test	44.91	4.54	1.07	41.96	17	0.000

Intervention Assessment

Carmen Questionnaire – Dispatchers and Rice Mill Machine Operators

Table 19 reveal that a systematic job rotation for dispatchers and job description for rice mill machine operators has a positive effect on lowering the cognitive risk experienced by the dispatchers and rice mill machine operators, with a t-test value of 12.33 (p-value = 000), that confirms this variability is highly significant ($p<0.05$), which provides strong evidence to reject the null hypothesis. The result suggests that the intervention effectively reduced the cognitive demands placed on workers, potentially leading to improved productivity, decision-making capabilities, and overall job satisfaction.

Table 19. Paired Sample Test

	Mean	Std. Deviation	Std. Error Mean	T-value	Degrees of Freedom (n – 1)	P-value (2-paired)
CarmenQ Mean Pre-test and Post-test	0.65	0.12	0.05	12.33	4	0.000

NASA – TLX – Baggers and Rice Mill Machine Operators

Table 20. Paired Sample Test.

	Mean	Std. Deviation	Std. Error Mean	T-value	Degrees of Freedom (n – 1)	P-value (2-paired)
NASA – TLX Mean Pre-test and Post-test	1.04	0.83	0.04	25.0	3	0.000

Table 20 analysis indicates that systematic job rotation and clearly defined job descriptions are positively correlated with a reduction in mental workload, with t-test results ($t = 25.0$, $p = 0.000$) validating the statistical significance of this reduction ($p < 0.05$). These findings demonstrate that the intervention effectively reduces cognitive strain across six workload dimensions, contributing to potential improvements in efficiency, accuracy, and overall worker well-being

Productivity Ratio

The productivity ratio is illustrated through the employees' absenteeism, which reflects the operational efficiency of the workforce. The initial and final absenteeism rates observed during a 30-day measurement are depicted below.

As indicated in Table 21, absenteeism rates dropped from 25% to 67% after the intervention proposed by the researchers, indicating that productivity has also improved proportionally. Since low absenteeism indicates enhanced worker efficiency, improved job satisfaction, and equal workload distribution among the workforce due to workplace interventions such as job rotation.

Table 21. Initial and final productivity ratio.

Area	No. of workers	Total monthly workdays	Initial absent days	Absenteeism ratio (initial)	Final absent days	Absenteeism ratio (final)	Improvement percentage
Porters	16	416	39	9.38%	22	5.29%	43.59%
Bran porters	2	52	6	11.54%	2	3.85%	66.67%
Bagging area	2	52	4	7.69%	3	5.77%	25.00%
Operating area	2	52	5	9.62%	2	3.85%	60.00%
Dispatch area	3	78	8	10.26%	5	6.41%	37.50%

DISCUSSION

Based on multiple ergonomic assessment tools, evaluations were conducted to examine the physical, cognitive, and environmental ergonomics of work conditions among workers in the rice milling industry. The results revealed that workers such as porters and bran porters are in need of physical ergonomic interventions, while baggers, dispatchers, and rice mill machine operators require cognitive ergonomic support. In response to these findings, the researchers proposed a set of ergonomic interventions, which were further refined and validated through a Focus Group Discussion (FGD) with the company's stakeholders to ensure feasibility within the context of company policies and operational constraints. Following the company's stakeholders' feedback and necessary revisions, the proposed interventions were finalized and approved.

To mitigate the risk of musculoskeletal disorders among porters and bran porters, the implementation of job rotation was recommended. Supported by ergonomic literature and guidelines from the Occupational Safety and Health Administration (OSHA), it is recommended

that job rotation occur every two hours to promote equitable physical workload distribution and reduce muscle fatigue associated with lactic acid buildup. Recognizing its benefit, the researchers also recommended a two-hour job rotation for dispatchers and baggers to address both physical and cognitive workload demands. However, company stakeholders raised operational concerns regarding the frequent rotation of dispatchers, emphasizing that shifting tasks every two hours could result in confusion and increased errors due to the continuous flow of customers. As a compromise, stakeholders proposed a daily rotation for dispatchers, rather than every two hours, balancing ergonomic benefits with operational efficiency. Additionally, to address the cognitive strain and uneven distribution of responsibilities among rice mill machine operators, the researchers proposed a revised job description that divides the roles of the head and assistant operators. While both are capable of performing basic operational tasks, specific key responsibilities such as batch milling calculations and performance evaluations remain designated to the head operator, by company protocols. This intervention aims to foster a more balanced cognitive workload and improve task clarity.

To evaluate the effectiveness of the ergonomic intervention, the researchers employed a two-sample t-test to determine whether there was a statistically significant difference in the levels of physical and cognitive strain experienced by workers before and after the intervention. This analysis was based on pre-test and post-test surveys conducted over a one-month implementation and observation period, using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), the Cognitive and Mental Workload Questionnaire (CarMen-Q), and the NASA Task Load Index (NASA-TLX). The results revealed that the ergonomic interventions, such as the implementation of systematic job rotations and the revision of job descriptions, had a significant positive impact on worker well-being and productivity. The statistical analysis yielded a p-value less than the conventional significance threshold ($p < 0.05$), indicating that the interventions effectively improved workplace conditions and reduced the physical and cognitive strain experienced by workers.

To further validate the effectiveness and efficiency of the interventions, the researchers assessed worker productivity through absenteeism rates. Following the implementation of the proposed ergonomic strategies, the absenteeism ratio dropped significantly, from 25% to 67%. This substantial decrease suggests improved productivity, job satisfaction, and more equitable workload distribution among workers.

CONCLUSION

The study identified that implementing systematic job rotation every two hours significantly reduced the risk of MSDs, with t-test results confirming a statistically significant improvement ($p < 0.05$) in musculoskeletal discomfort. Furthermore, the introduction of systematic job rotation and defined job descriptions effectively lowered mental workload for these workers, as confirmed by the t-test. These work practices also result in boosting workers' productivity, and lessen the cases of absenteeism with an improvement percentage ranging from 25 to 66.67%. In addition, excessive heat (34.0°C), humidity (64%), and noise levels (89.1 dBA) exceeded recommended occupational safety limits, affecting worker well-being.

Proactive measures–such as ventilation improvements, noise control strategies, and appropriate protective equipment–are necessary to create a safer and more productive working environment.

The researchers recommended that rice milling management implement job rotation strategies to reduce the risk of musculoskeletal disorders (MSDs) among workers. Additionally, increasing the number of workers assigned to these high-risk areas can further reduce individual lifting frequency and associated strain. To address poor lifting postures observed, companies should consider investing in adjustable pallets. These would enable lifting at waist level, encouraging a neutral spine position and reducing the risk of lower back injuries. Moreover, the use of hearing protection should be mandated in areas with high noise exposure, particularly the bagging and operating sections, in line with OSHA standards, to prevent long-term hearing damage. It is also strongly recommended that future researchers include the assessment of air quality monitoring devices to measure dust particles within the facility. Maintaining acceptable dust levels not only enhances workplace safety but also supports product quality and compliance with occupational health regulations.

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REFERENCES

Amanullah, & Shah Fahad. (2017). Rice - Technology and Production. *In InTech eBooks*. https://doi.org/10.5772/64480

Astuti, R. D., Susmartini, S., & Kinanthi, A. P. (2017). Improving the work position of worker based on manual material handling in rice mill industry. *AIP Conference Proceedings*, *1902*, 020043. https://doi.org/10.1063/1.5010660

Centers for Disease Control and Prevention. (2024). Revised NIOSH Lifting Equation. Ergonomics and Musculoskeletal Disorders. *Centers for Disease Control and Prevention.* https://www.cdc.gov/niosh/ergonomics/about/RNLE.html

de Oliveira Sato, T., & Cote Gil Coury, H. J. (2009). Evaluation of musculoskeletal health outcomes in the context of job rotation and multifunctional jobs. *Applied Ergonomics*, *40*(4), 707–712. https://doi.org/10.1016/j.apergo.2008.06.005

Maulana Rosyidi, Auditya Purwandini Sutarto, & Nailul Izzah. (2023). Addressing Ergonomics in Paddy Milling: Insights from RULA, Nordic Body Map, and Anthropometry. *Qomaruna*, *1*(1), 1–14. https://doi.org/10.62048/qjms.v1i1.21

Mehta, R. K. (2016). Integrating Physical and Cognitive Ergonomics. *IIE Transactions on Occupational Ergonomics and Human Factors*, *4*(2-3), 83–87. https://doi.org/10.1080/21577323.2016.1207475

Mlekus, L., & Maier, G. W. (2021). More Hype Than Substance? A Meta-Analysis on Job and Task

Rotation. *Frontiers in Psychology*, *12*(12). https://doi.org/10.3389/fpsyg.2021.633530

Moradpour, Z., Jafari, M. J., Dehghan, S. F., Jalali, M., & Hesam, G. (2024). Heat stress, thermal comfort and control strategy in a warm-humid workplace. International Journal of Biometeorology, 68(12), 2507–2514. https://doi.org/10.1007/s00484-024-02760-z

Occupational Safety and Health Administration. (2002). Temporary Worker Initiative Noise Exposure and Hearing Conservation. *U.S. Department of Labor.* https://www.osha.gov/sites/default/files/publications/OSHA3953.pdf

Ojukwu, C. P., Anyanwu, G. E., Nwabueze, A. C., Anekwu, E. M., & Chukwu, S. C. (2017). Prevalence and associated factors of work related musculoskeletal disorders among commercial milling machine operators in South-Eastern Nigerian markets. *Work*, *58*(4), 473–480. https://doi.org/10.3233/wor-17264

Padula, R. S., Comper, M. L. C., Sparer, E. H., & Dennerlein, J. T. (2016). Job rotation designed to prevent musculoskeletal disorders and control risk in manufacturing industries: A systematic review. *Applied Ergonomics*, *58*, *386–397.* https://doi.org/10.1016/j.apergo.2016.07.018

Philippine Rice Research Institute - Data Analytics Center. (2023). State of the Rice Sector in Occidental Mindoro. *Philrice.gov.ph.* https://www.philrice.gov.ph/ricelytics/main/province/51

Reiman, A., Kaivo-Oja, J., Parviainen, E., Takala, E., & Lauraeus, T. (2021). Human factors and ergonomics in manufacturing in the industry 4.0 context – A scoping review. *Technology in Society*, *65*, 101572. https://doi.org/10.1016/j.techsoc.2021.101572

Rezvanizadeh, M., Mohammad-Ghasemi, M., Soltanzadeh, A., & Sadeghi-Yarandi, M. (2023). Development of a novel ergonomic index assessment in the workplace based on physical, cognitive, and environmental components. *Work*, *75*(3), 1071–1086. https://doi.org/10.3233/wor-220335

Shiddiqy, I. A., Bisnis, D., & Semarang, J. (2023). Benefits Of Job Rotation: Systematic Literature Review (SLR). *Jurnal Manuhara : Pusat Penelitian Ilmu Manajemen Dan Bisnis*, *2*(1), 144–151. https://doi.org/10.61132/manuhara.v2i1.440

Silva, D. R., De Jesus Laurenço, A., Galvão, J. Q., De Oliveira Lopes, M. E., De Oliveira Barros, Y., Araújo, C. a. P., Da Silva, J. V., Calazans, M. L., Silva, W. S. L., Gomes, E. M., & De Paula, J. S. (2024). Impact of ergonomics on workers' performance and health. *International Journal of Advanced Engineering Research and Science*, *11*(10), 44–58. https://doi.org/10.22161/ijaers.1110.5

The National Institute for Occupational Safety and Health (NIOSH). (2007). Ergonomic guidelines for manual material handling. *Centers for Disease Control and Prevention* . (2007). https://doi.org/10.26616/nioshpub2007131

World Health Organization. (2022). Musculoskeletal health. *World Health Organization: WHO.* https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions

RESEARCH ARTICLE

DEVELOPMENT OF A WATER QUALITY PREDICTION MODEL THROUGH THE UTILIZATION OF SOLAR-POWERED PHYTOREMEDIATION WATER TREATMENT POOL IN IMPROVING THE WATER QUALITY OF PANDURUCAN RIVER, SAN JOSE, OCCIDENTAL MINDORO

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ABSTRACT

The Pandurucan River is vital for agriculture, fisheries, and domestic use in San Jose, Occidental Mindoro. However, it is currently suffering from severe water quality issues caused by pollution from surrounding agricultural and residential lands. To improve its water quality, Scatter Linear Regression, Analytic Hierarchy Process (AHP), and ArcGIS were utilized in this research to develop a water quality prediction model, analyzing the significant parameters such as temperature, pH, dissolved oxygen, chloride, TSS, nitrate, and phosphate. The Water Quality Guidelines and Effluent Standards of 2016 (DAO 2016-08) were followed during the water quality monitoring, and the Analytic Hierarchy Process (AHP) was used to determine parameter weights for map generation. This water quality assessment revealed high chloride and phosphate level contents, low dissolved oxygen, and saltwater intrusion, where all stations failed in the Water Quality Index (WQI), particularly in Brgy. San Roque. Further, the Solar-Powered Phytoremediation Water Treatment Pool efficiently improved all water quality parameters, as visualized in the ArcGIS-based model. This result was validated using the R-squared (R^2) method, which ensured that the prediction model efficiently captured water quality variations, being a reliable tool for environmental management.

Keywords: *analytical hierarchy process, effluent standards, geographical information system, water quality prediction model, water quality guidelines, water quality parameters*

SDG: *SDG 6: Clean Water and Sanitation, SDG 13: Climate Action*

INTRODUCTION

Water pollution remains a global concern due to population growth, urbanization, and industrialization. The disposal of untreated wastes from industries, agriculture, and households damage the ecosystem, disease transmission, and water scarcity (Md Anawar & Chowdhury, 2020). The survey conducted by United Nations Environment Programme in 89 countries, revealed that over 40 percent of the 75,000 water bodies were severely polluted (Murray, 2021). Considering the increasing demand for water worldwide, it is a pressing need to focus on the importance of water management through sustainable water and wastewater treatment.

Water pollution in the Philippines threatens the health, the economy and the environment. Half of the country's drinking water comes from the 421 rivers and 221 lakes and 43% of the country's rivers and 56% of the country's major water bodies are considered polluted (Philippine Institute for Development Studies, 2024). Thus, led to the implementation of the Philippine Clean Water Act of 2004 were community-driven initiatives were laid out to improve the water quality (Republic Act No. 9275, 2004).

Locally, Pandurucan River, one of the 11 rivers traversing in San Jose, Occidental Mindoro has been showing signs of pollution due to the improper waste disposal practices of the surrounding community (Muyot, 2022). The water quality monitoring conducted in Pandurucan River discovered the poor water quality index and was considered unsuitable for recreational activities. Further, the river is considered impaired and deteriorating from the industrial discharges, poor waste management, and agricultural runoff (Enriquez & Tanhueco, 2022). As the rehabilitation of the Pandurucan River becomes a priority project of the Local Government Unit of San Jose, efforts are laid out to realize the revival of the Pandurucan River.

One particular rehabilitation technique for water bodies is the remediation process, a measure taken by water utilities to restore safe and regular service after contamination and ensure that water is safe for public use and the environment (U.S. Environmental Protection Agency, 2021). Effective remediation requires the identification of the contaminant, the behavior of the spread, and the application of suitable treatment methods to eliminate the threat and prevent long-term damage (Padhye et al., 2023). Phytoremediation is an innovative and sustainable method for rehabilitating environments contaminated by heavy metals and pollutants, particularly in water bodies (Pang et al., 2023). This eco-friendly approach harnesses the natural capabilities of specific plants to absorb harmful substances from their surroundings and, in return, release non-toxic byproducts into the ecosystem (Verma & Jadhav, 2021). Among the various techniques utilized in phytoremediation, using aquatic plants as biofilters has shown significant promise for effective water treatment (Gorito et al., 2017). Research indicates that free-floating aquatic plants such as water hyacinth, water ferns, duckweeds, water lettuce, and watercress possess remarkable properties that enable them to extract heavy metals from polluted environments. These plants draw metals through their root systems, facilitating the passive transport of contaminants upwards within the plant structure, ultimately leading to their accumulation in the upper parts of the plant (Priya et al., 2023).

Furthermore, water quality prediction plays an important role in protecting water resources and addressing the growing water crisis; the intelligent algorithms provided as the prediction model enable proactive measures for pollution prevention, better water

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management, and informed decision-making (Wu et al., 2022). Additionally, Geographic Information Systems (GIS) have proven effective in analyzing water quality data (DeepChand et al., 2022). This study explored these advanced approaches as valuable tools for characterizing both current and future water quality.

As an important river in San Jose, Occidental Mindoro, Pandurucan River receives concern on reviving the water quality of the recreational water. The Municipal Environment Office of the local government of San Jose had prioritized the Rehabilitation project of the Pandurucan River. As the unit is formulating its water rehabilitation plan for the Pandurucan River, this study could provide substantial information on implementing cost-effective and sustainable strategies. This study offers sustainable strategies that could be presented to the local government to improve the quality of the Pandurucan River. The water quality analysis performed in the study can serve as the backbone of the rehabilitation plan; the developed solar-powered phytoremediation water treatment pool is the cost-effective approach, while the water quality prediction model as part of the sustainable plan in safeguarding the water quality of Pandurucan river. The water quality monitoring plan guided the researchers in the water sampling testing, and analysis of the results was modeled in ArcGIS to determine the behavior of contaminants before and after the implementation of the phytoremediation process.

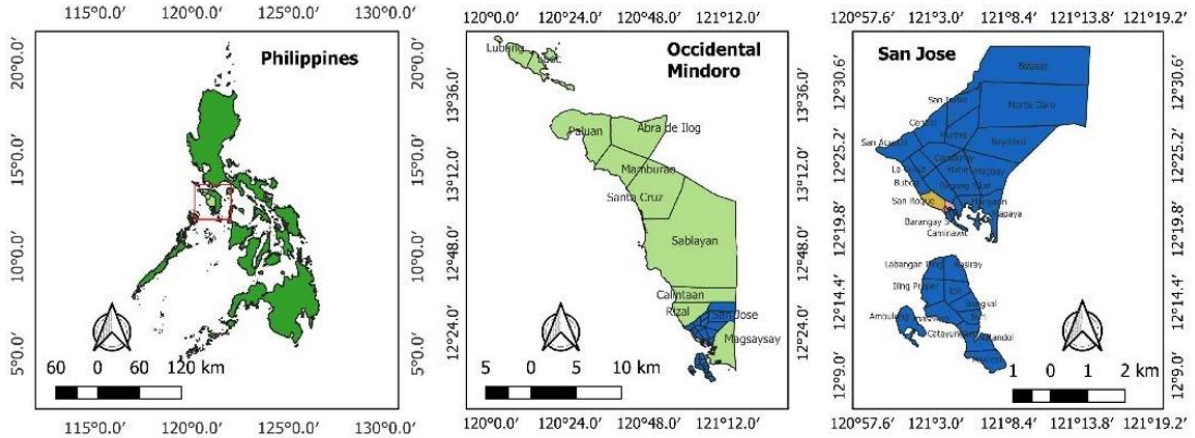
METHODS

Research Design

The research design of the study applied the quantitative method by incorporating both assessment and experimental methods to evaluate the water quality of the Pandurucan River. It focused on monitoring water quality parameters before and after the installation of phytoremediation water treatment pool to determine its effectiveness following the DENR-EMB DAO 2016-08 and utilized ArcGIS for spatial modeling and analysis of the data collected from the sampling stations.

Study Site

The study conducted within the span of Pandurucan River. Figure 2 shows the four identified sampling locations used in the study.



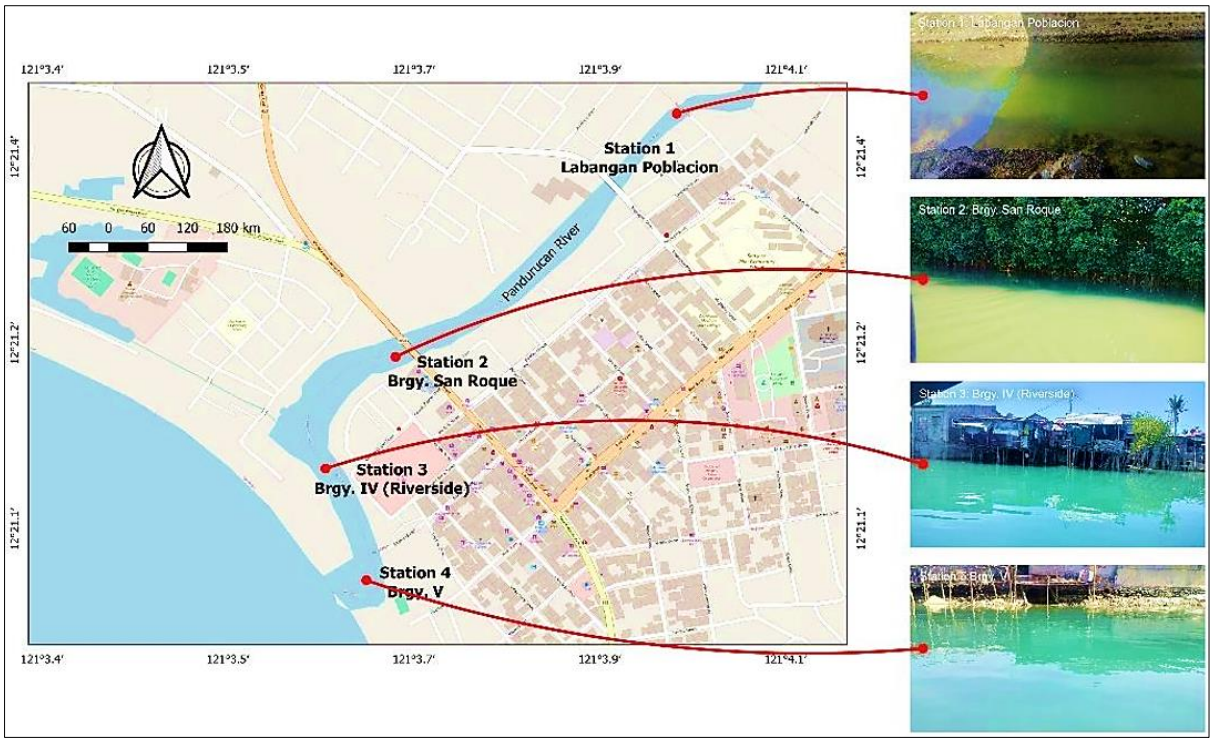


Fig. 1. Map of the Pandurucan River with four identified sampling locations generated from QGIS 3.36.1.

The study covered the upstream, midstream, and downstream sections of the Pandurucan River, with four sampling stations identified for water collection and analysis. The stations were strategically selected based on river classification: Labangan as the upstream section, Barangay San Roque and Barangay IV as the midstream, and Barangay V as the downstream where the river water merges with saltwater. Table 1 shows the location of the sampling site as well as its description.

Table 1. Description and profile of sampling sites.

Stations	Description
Station 1: Labangan, Poblacion	The station is located 12°21'27"N 121°03'58"E at Labangan, San Jose, Occidental Mindoro; located near the mangrove areas and riverbanks; with surrounding areas for agriculture and some commercial and residential areas.
Station 2: San Roque	Station 2, located at 12°21'14"N, 121°03'44"E in Barangay San Roque, San Jose, Occidental Mindoro, situated near the Pandurucan Bridge. The area surrounding the station, including the river and its banks, have scattered garbage along the mangroves.

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Station 3: Barangay IV (Riverside)	Station 3, located at 12°21'07"N, 121°03'37"E in Barangay IV, San Jose, Occidental Mindoro, is at riverside area surrounded by residential and commercial buildings. The water has visible garbage, greenish-brown water, and a foul smell with riverbed covered by muddy clay.
Station 4: Barangay V	The station 4 is at 12°21'02"N, 121°03'40"E in Barangay 5, San Jose Occidental Mindoro surrounded by residential, commercial, and agricultural land. The river water has garbage along the banks with muddy and brownish water.

Sample Collection

The study used manual sampling and grab water samples, as the Pandurucan River was not wadable. One sample was collected from each of the four stations between January 24 and February 7, 2025, excluding rainfall events, and following DAO 2016-08 guidelines. Sampling took place from 10:00 AM to 12:00 PM.

Water samples for chloride, TSS, nitrate as NO_3-N, and phosphate were collected and brought to the accredited Department of Health (DOH) Laboratory for physicochemical analysis at First Analytical Services and Technical Cooperative (FAST Laboratories) located in Brgy. San Rafael, Santo Tomas, Batangas. Water samples were placed on the container and kept in a cool box at about 6 °C as recommended by the laboratory.

Furthermore, after fabricating the prototype, the installation followed, and the location was determined using the calculated WQI. Water lettuce was selected for phytoremediation and placed in the prototype after proper cleaning. Water quality was monitored, with samples collected and analyzed from February 20 to March 5, 2025.

Sample Analysis

In the analysis of grab water samples, both in-situ measurements and laboratory analysis were employed to obtain comprehensive data about the water quality. The parameters temperature, pH level, and DO were taken in-situ analysis using the digital DO Meter while parameters chloride, TSS, nitrate as NO3-N, and phosphate were analyzed in laboratory.

Design and Development of the Solar-Powered Water Treatment Pool

The design of the solar-powered phytoremediation water treatment pool was made using AutoCAD which incorporated structural, electrical, and phytoremediation components for the effective and sustainable water treatment of the Pandurucan River. The structure of the prototype was designed as an octagonal cylindrical framework built through welded reinforced tubular steel and steel bars. On the other hand, its electrical system includes a 120W solar panel mounted on a metal frame to maximize sunlight exposure and to power a solar charge controller, a 12V lead-acid battery, and a 12V-500W inverter, enabling the operation of a smart water quality sensor that records real-time water conditions. For the phytoremediation, 40 medium-sized water lettuce plants were collected, cleaned, and placed in the pool at a moderate biomass density.

Ethical Consideration

The researchers followed all the necessary guidelines to ensure the study was carried out responsibly and ethically. The permission was obtained from the barangay before the installation of the water treatment pool. Moreover, all procedures involving water collection and analysis were performed in compliance with established environmental regulations and standards, ensuring the integrity and safety of the research process. The aquatic plants used for the treatment were responsibly sourced, and the study did not harm the river or its surroundings. The researchers ensured data accuracy, kept necessary information confidential, and presented the results transparently throughout the research.

Data Analysis

The researchers used the Canadian Council of Ministers of the Environment (CCME) method to calculate the WQI for each station to identify the most polluted sampling location after using the digital water quality meter and conducting the laboratory analysis. The station with the lowest WQI score was chosen as the site for the installation of the Solar-Powered Water Treatment Pool. The t-test was performed through comparing the water quality data before and after the installation to determine the effectiveness the water treatment pool. A p-value below 0.05 indicated that the treatment had a measurable effect.

The study also use the Geographic Information System (GIS) tools, scatter linear regression, and the Analytical Hierarchy Process (AHP). The water quality and prediction models were developed both before and after the phytoremediation process using ArcGIS 10.7.1. The regression analysis was used to forecast water quality trends over a five-year period. Meanwhile, AHP helped determine the weight or importance of each water quality parameter by consulting experts from the local sanitary office, barangay health officials, and representative from the Prime Water. The experts compared each parameter using Saaty's 1–9 scale to reflect its relative importance in evaluating water quality.

RESULTS

Water Quality Parameters Testing Results

Following the water quality monitoring plan presented in Chapter 3, the sampling methodology was carefully conducted, and all measured values were recorded and analyzed. The results of water samples taken from the four (4) designated sampling stations from January 14, 2025 to February 7, 2025.

Figure 2 shows the varying results of the water quality parameters across the four sampling stations. Temperature ranged from 28.60°C to 31.80°C, with some readings exceeding the DAO 2016-08 standard of 26°C to 30°C. The pH levels ranged from 6.65 to 8.26, indicating alkaline water. DO levels were mostly below the 5 mg/L standard, with Brgy. V recording the highest levels, suggesting better water quality, while Brgy. San Roque had the lowest levels, indicating pollution and reduced oxygen due to slower water flow and higher temperatures. Chloride concentrations exceeded the 250 mg/L limit at all stations due to saltwater intrusion, with Brgy. V having the highest levels. TSS remained within the 65 mg/L limit, with Brgy. IV showing the highest TSS. The nitrate as NO_3–N levels were within the 7 mg/L limit, with Brgy. IV

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having the highest concentration of 0.30 mg/L while phosphate levels exceeded the 0.5 mg/L standard at all stations, with Brgy. Labangan recording the highest value.

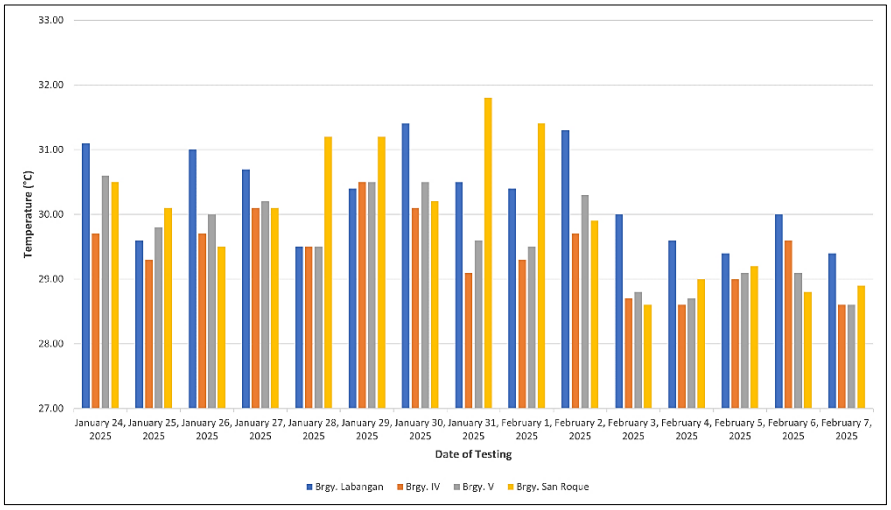

Fig. 2a. Temperature before the phytoremediation treatment

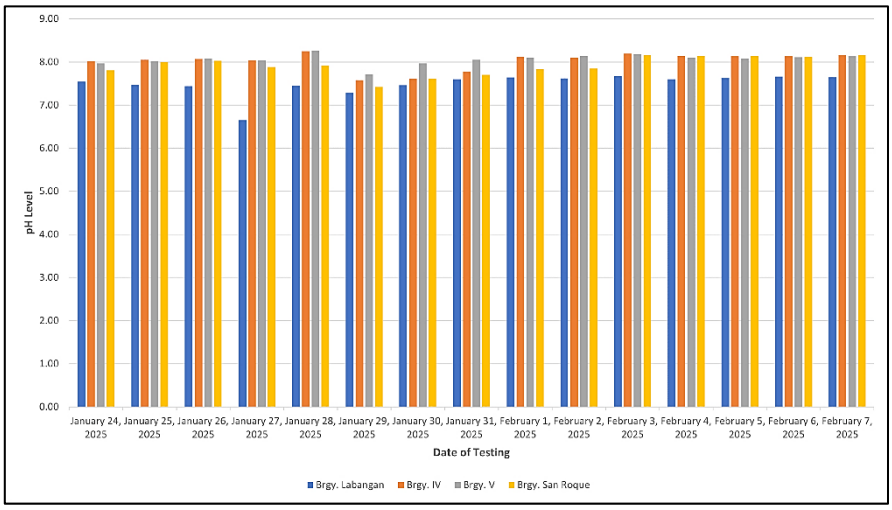

Fig. 2b. pH level before the phytoremediation treatment

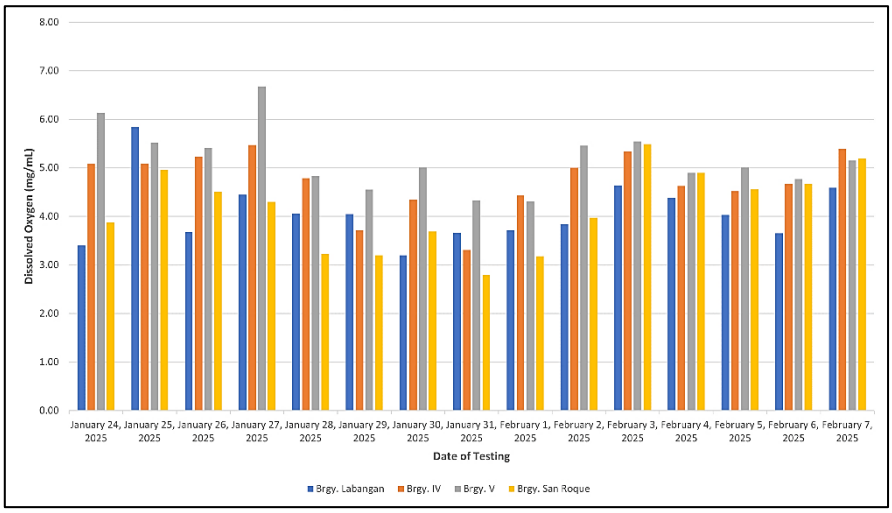

Fig. 2c. Dissolved oxygen before the phytoremediation treatment.

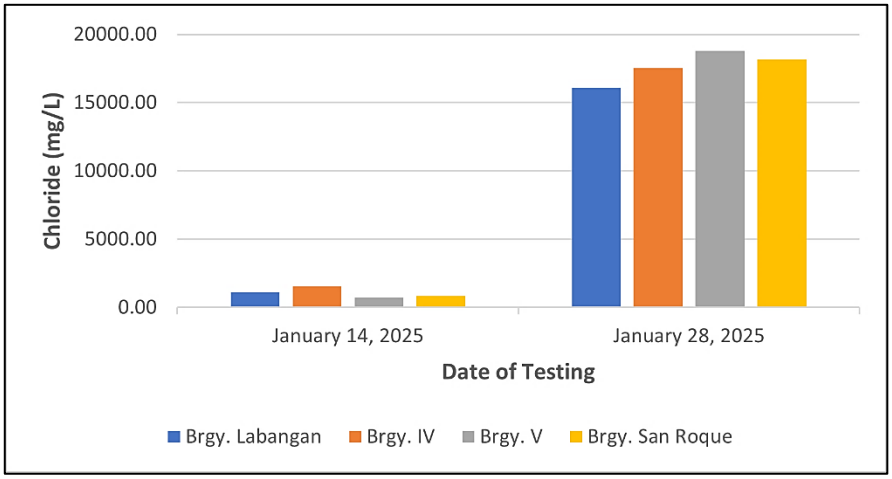

Fig. 2d. Dissolved oxygen before the phytoremediation treatment.

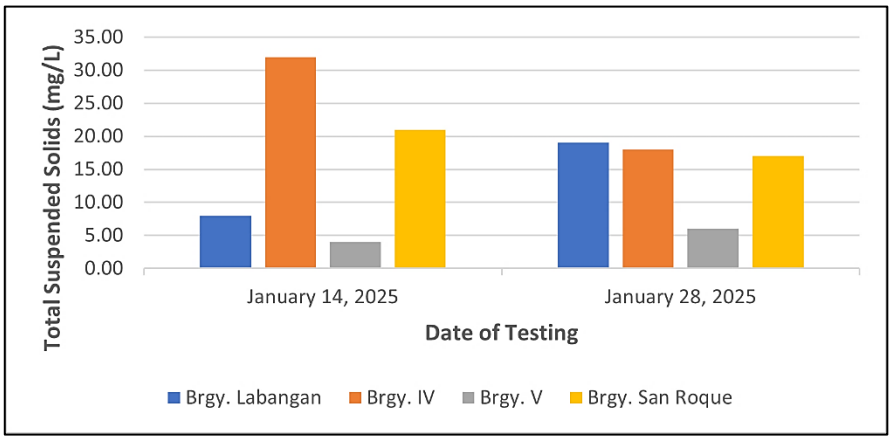

Fig. 2e. Dissolved oxygen before the phytoremediation treatment.

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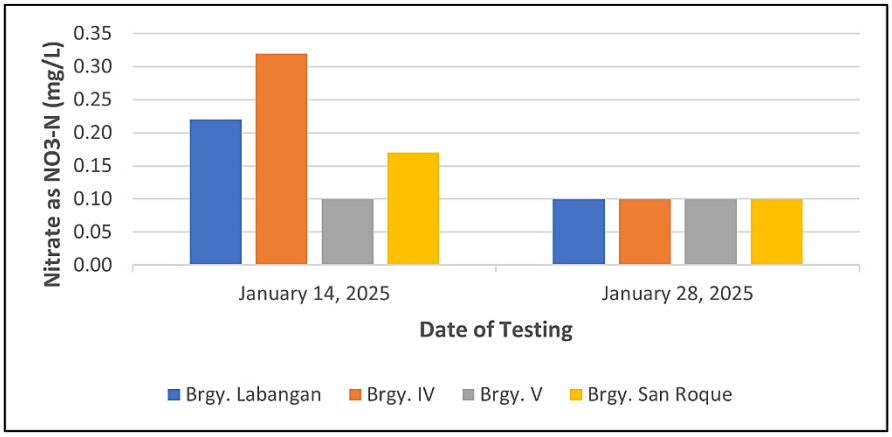

Fig. 2f. Nitrate as NO3-N before the phytoremediation treatment.

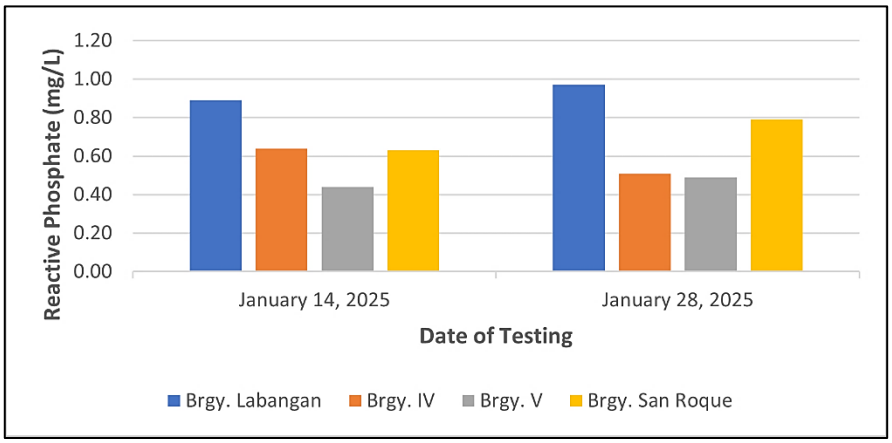

Fig. 2g. Reactive phosphate before the phytoremediation treatment.

Water Quality Index Values

After analyzing the water samples, the researchers determined the WQI for each sampling station using the CCME method. The assessment integrated the water quality parameters into a single index value to reflect the overall water quality.

Table 8 shows the computed WQI for all four stations indicated poor water quality. The results suggested that the Pandurucan River is consistently threatened by environmental factors. Among the sampling stations, Brgy. San Roque has the lowest WQI, indicating having the poorest water quality.

Table 8. Water Quality Index of the four sampling stations.

Sampling Stations	Computed WQI	Rank	Description
Labangan	28.8328	Poor	Water quality is almost always threatened or impaired; conditions usually depart from natural or desirable levels
San Roque	27.6342	Poor	
Brgy IV.	33.9890	Poor	
Brgy V.	41.4606	Poor	

Water Quality Testing Results with Phytoremediation Water Treatment Pool

After identifying the most polluted station, the water treatment pool was installed, and phytoremediation plants were added on February 18, 2025. Water quality analysis was conducted from February 20 to March 5, 2025, with in-situ tests for temperature, pH, and dissolved oxygen. Samples for chloride, TSS, nitrate (NO3–N), and phosphate were collected on February 27, 2025, and analyzed in the laboratory.

Figure 3 shows the result of the water quality monitoring after the installation of the water treatment pool at the Brgy. San Roque. The temperature remained stable between 27.9°C and 29.4°C. The pH stayed slightly alkaline, ranging from 7.4 to 7.83, and dissolved oxygen (DO) improved, meeting DAO 2016-08 standards. However, chloride levels at 16,600 mg/L still exceeded the standard. TSS and nitrate values were within the allowable limits of 14 mg/L and 7 mg/L, respectively, and phosphate levels were safe at 0.40 mg/L. The t-test confirmed significant improvements in DO (p = 0.00003), pH (p = 0.007), and temperature (p = 0.0008), demonstrating the effectiveness of the phytoremediation pool.

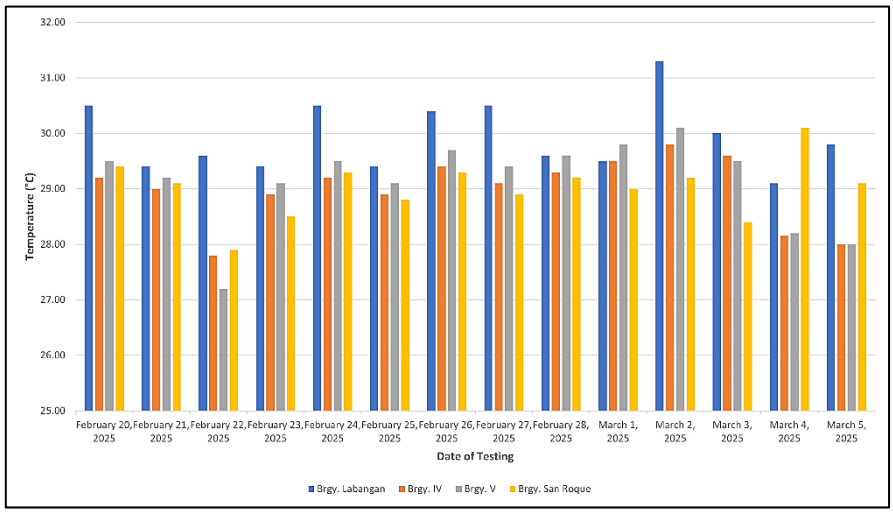

Fig. 3a. Temperature after the phytoremediation treatment.

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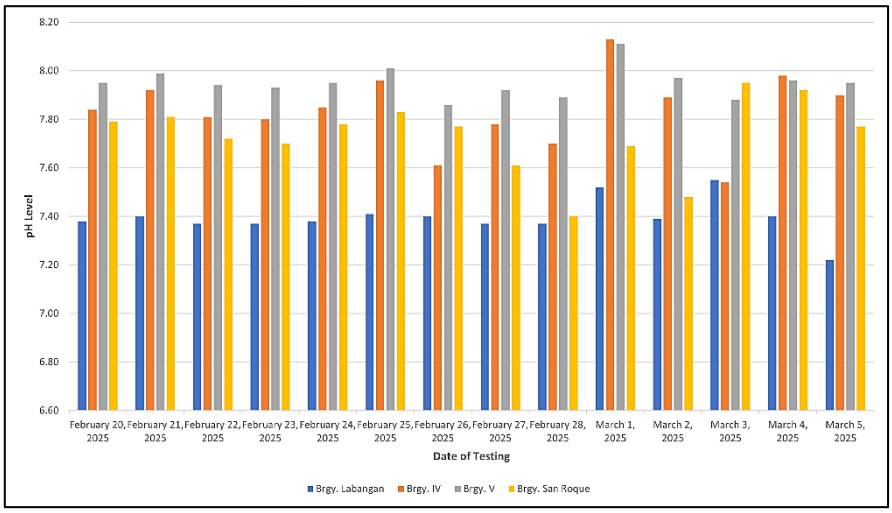

Fig. 3b. pH level after the phytoremediation treatment.

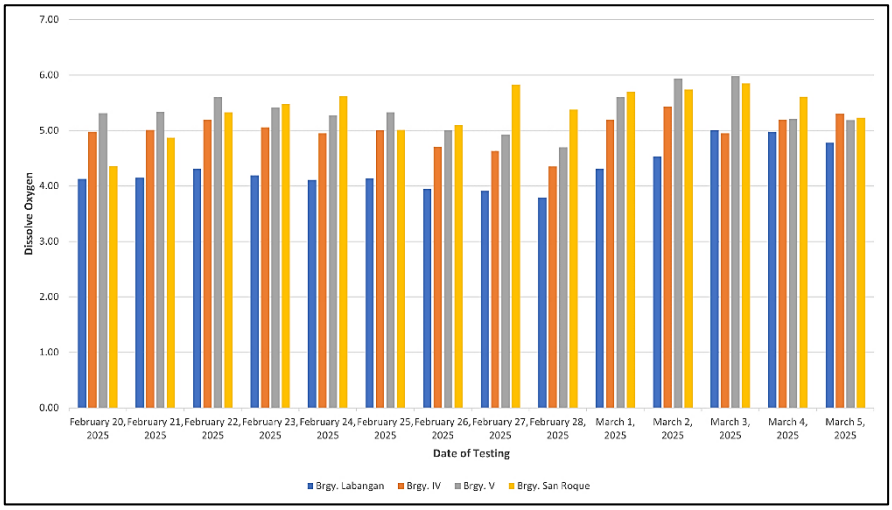

Fig. 3c. Dissolved oxygen after the phytoremediation treatment.

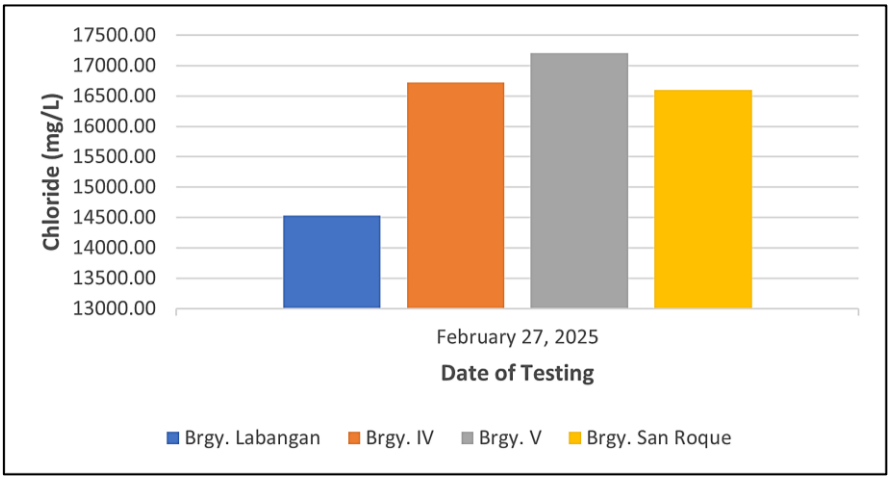

Fig. 3d. Chloride after the phytoremediation treatment.

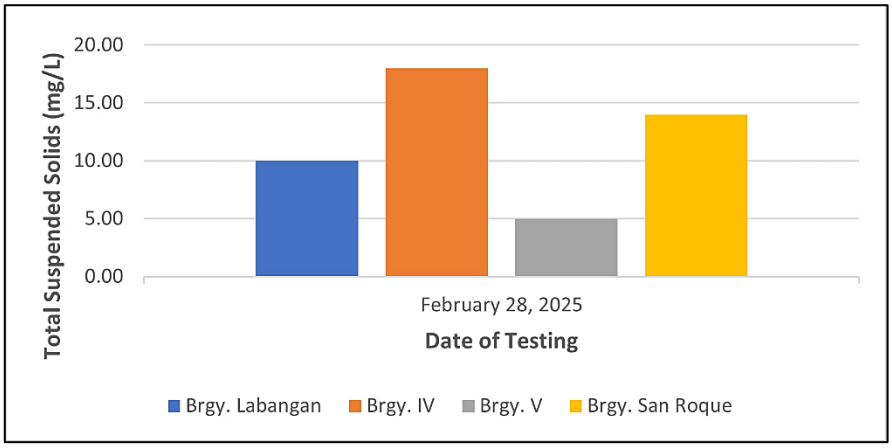

Fig. 3e. Total suspended after the phytoremediation treatment.

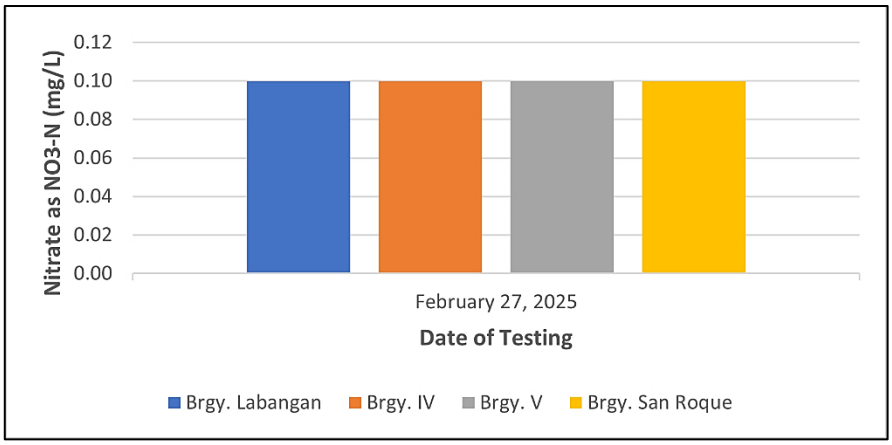

Fig. 3f. Nitrate as NO3-N after the phytoremediation treatment.

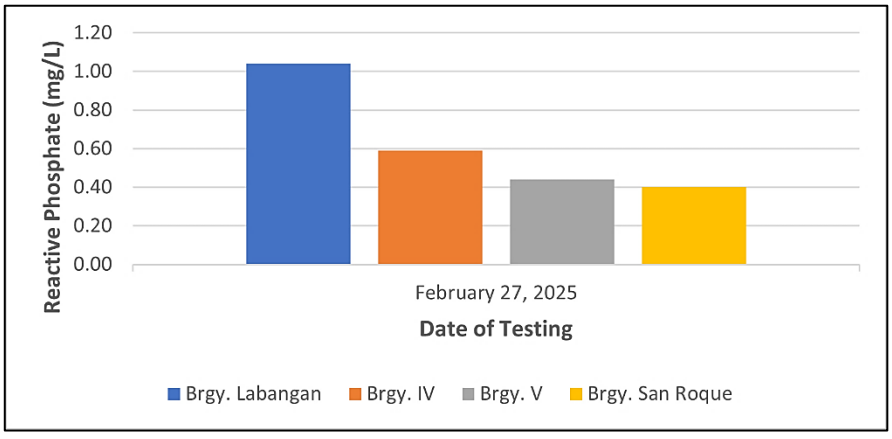

Fig. 3g. Reactive phosphate after the phytoremediation treatment.

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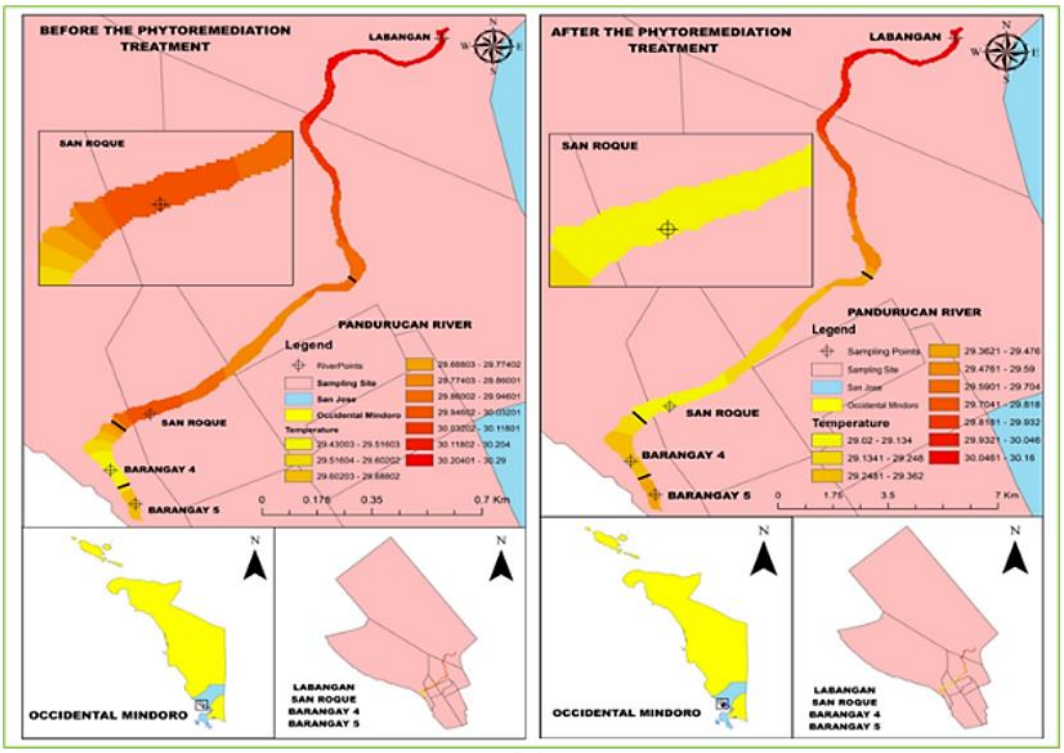
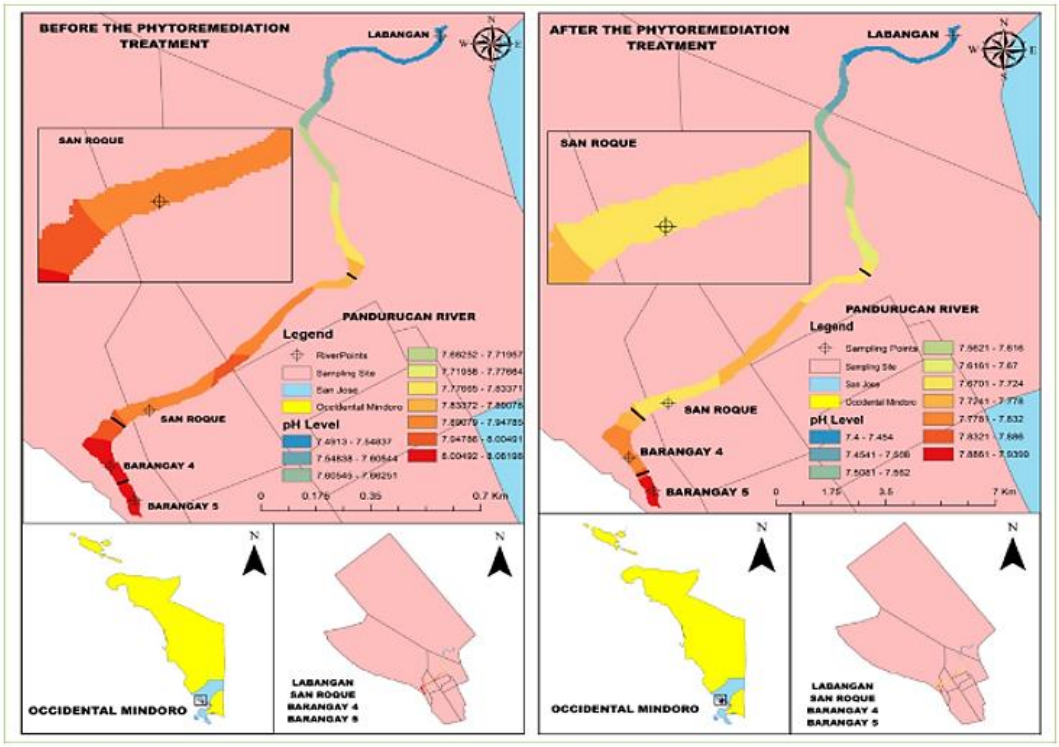
Water Quality Models

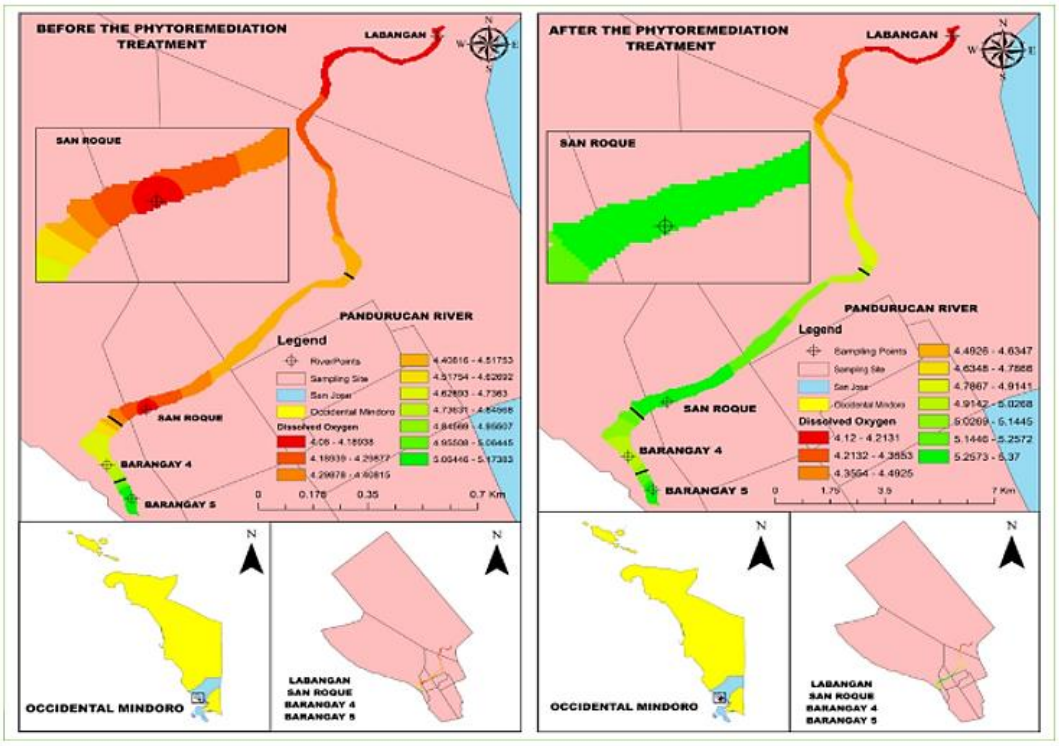
The water quality before and after the installation of phytoremediation pool in San Roque was analyzed using ArcGIS with the IDW interpolation method, generating spatial maps to visualize changes across all sampling stations and exhibited the following results.



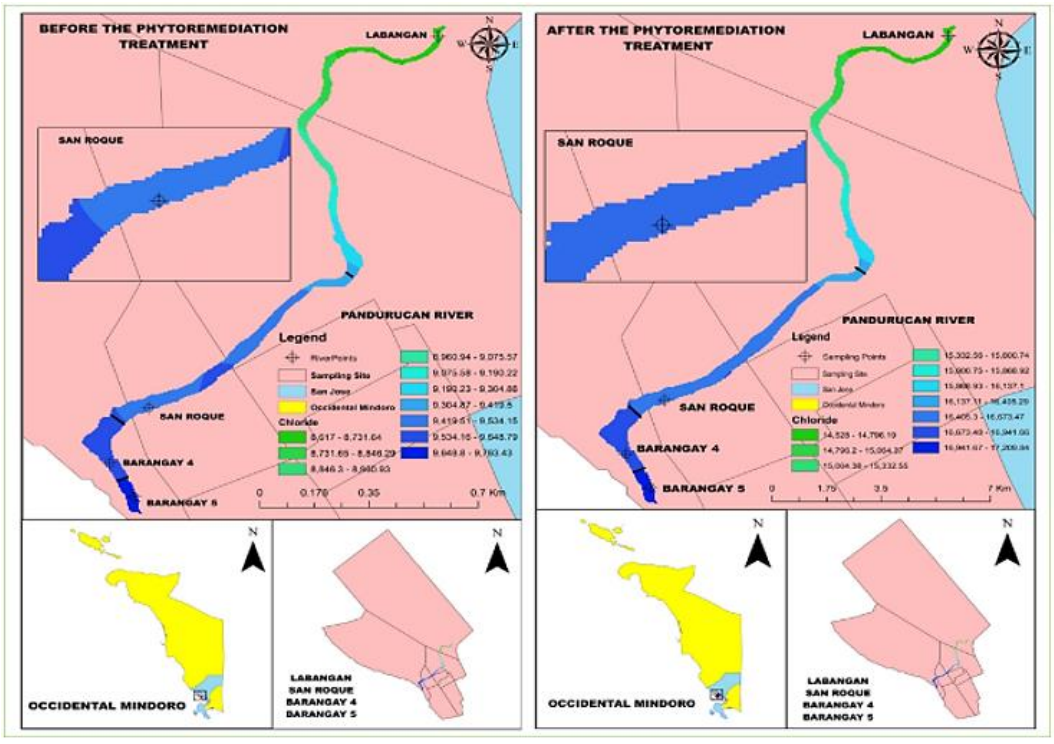
(a)



(b)


BEFORE THE PHYTOREMEDIATION TREATMENT
AFTER THE PHYTOREMEDIATION TREATMENT
LABANGAN
SAN ROQUE
PANDURUCAN RIVER
Legend
Dissolved Oxygen
BARANGAY 4
BARANGAY 5
OCCIDENTAL MINDORO
LABANGAN
SAN ROQUE
BARANGAY 4
BARANGAY 5

(c)


BEFORE THE PHYTOREMEDIATION TREATMENT
AFTER THE PHYTOREMEDIATION TREATMENT
LABANGAN
SAN ROQUE
PANDURUCAN RIVER
Legend
Chloride
BARANGAY 4
BARANGAY 5
OCCIDENTAL MINDORO
LABANGAN
SAN ROQUE
BARANGAY 4
BARANGAY 5

(d)

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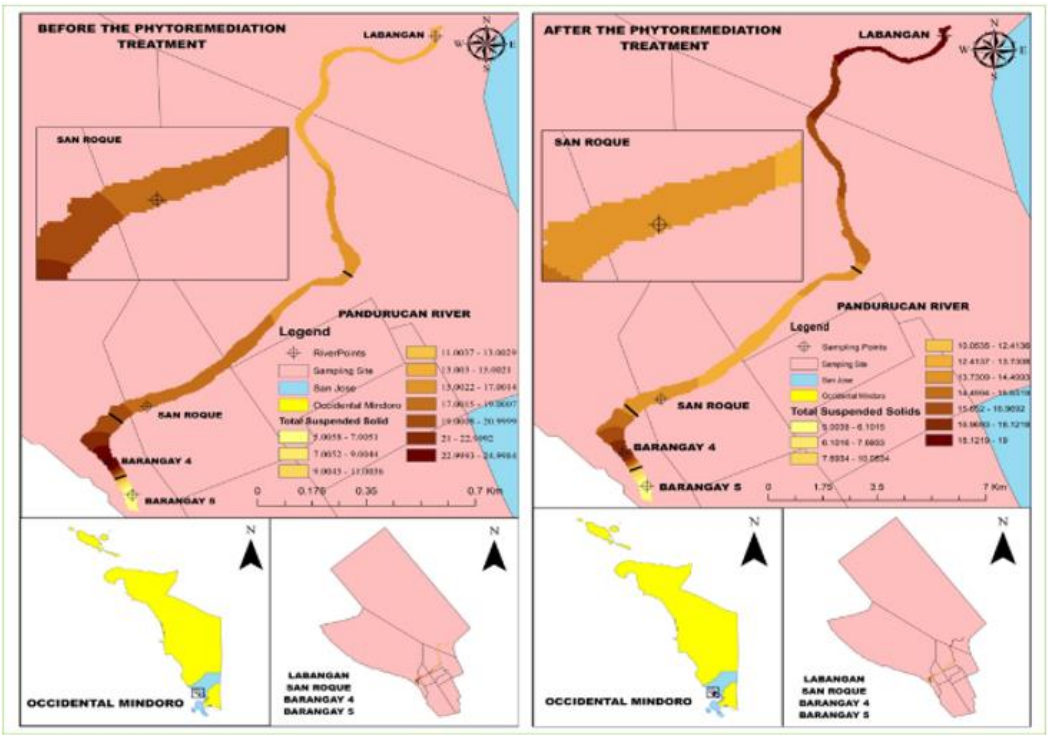
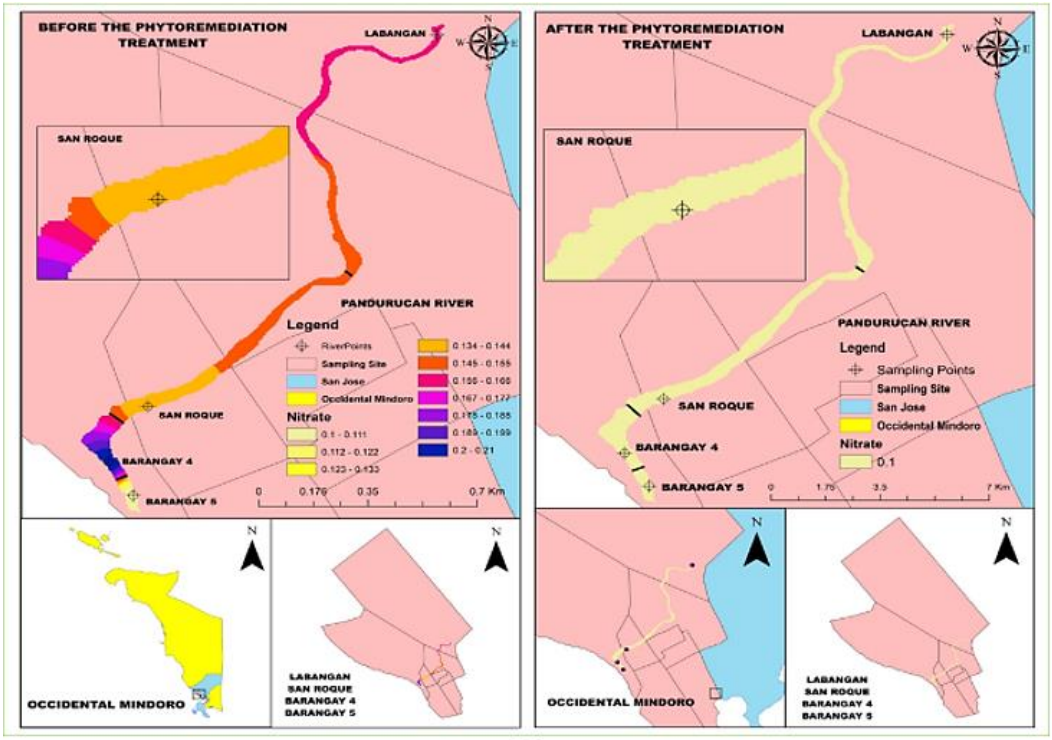
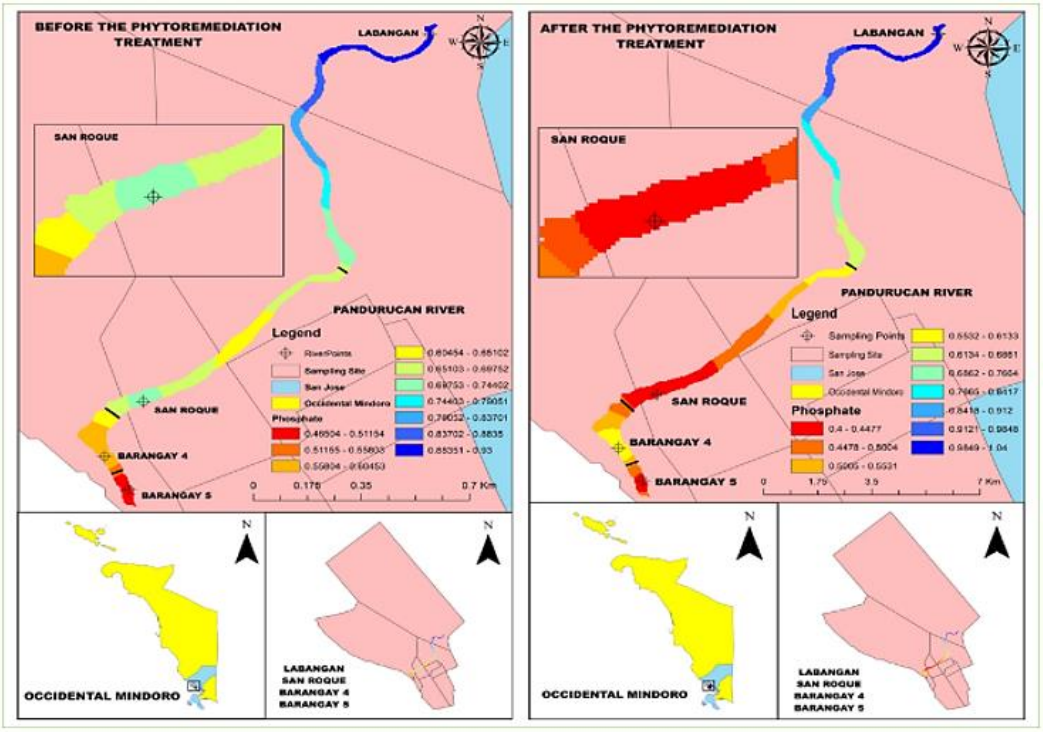


(e)



(f)



(g)

Fig. 4. Spatial maps of water quality parameters before and after the phytoremediation treatment: a) temperature; b) pH level; c) dissolved oxygen; d) chloride; e) total suspended solids; f) nitrate as NO_3-N; g) phosphate.

Figure 4 shows the generated map of water quality parameters before and after the installation of the phytoremediation treatment. The showed notable improvements in several key water quality parameters, particularly in San Roque, that was identified as the most polluted site before the application of the treatment pool. Before phytoremediation, the water temperature in Labangan and San Roque ranges from 29.86°C to 30.29°C with Brgy. IV has slightly lower values. After the installation of the water treatment pool, San Roque experienced a decrease in temperature, ranging from 29.02°C to 29.40°C. The pH levels before treatment varied, with Brgy. IV and Brgy. V becoming more alkaline, while San Roque had lower pH values between 7.49–7.94. After phytoremediation, pH levels in San Roque stabilized between 7.4 to 7.785. The DO levels improved significantly, particularly in San Roque, where values were critically low before the treatment. After the intervention, DO levels increased to 4.31 mg/L to 5.37 mg/L. The nitrate concentrations also showed a positive trend, decreasing from 0.1440–0.1879 mg/L in San Roque to 0.1 mg/L. The phytoremediation system effectively reduced TSS in San Roque, lowering levels from 17.0015–19.0007 mg/L to 12.801–14.1004 mg/L, and decreased phosphate concentrations, with values dropping from 0.69753–0.74402 mg/L to 0.4–0.464 mg/L. The chloride levels increased along the river, with the lowest values in Labangan and the highest in Brgy. V, but after phytoremediation, chloride concentrations in San Roque rose significantly to 14,528.02–17,209.84 mg/L.

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Water Quality Prediction Model

The water quality data collected after the installation of a phytoremediation treatment pool in the Pandurucan River was utilized to develop a predictive model. The researchers forecasted water quality parameter values for the next five (5) years using the scatter linear regression. The Analytical Hierarchy Process (AHP) was applied to systematically prioritize various water quality parameters based on the relative significance to enhance the reliability of the predictions. The DO was identified as the most significant water quality parameter by the experts from the sanitary office, barangay health office, and Prime Water management, followed by the nitrate, TSS, chloride, pH level, phosphate, and temperature. The integration of spatial analysis and statistical modeling provided a comprehensive framework for evaluating the long-term impacts of phytoremediation.

Figure 5 shows the generated map of the Pandurucan River's water quality after the implementation of phytoremediation treatment in Brgy. San Roque and the projected future conditions of the river. The water quality after the phytoremediation treatment in San Roque demonstrated a noticeable improvement. The presence of green and yellow zones in the treated section indicated a reduction in pollutant levels. However, in the downstream areas, particularly Barangay IV and Barangay V, still exhibited poor water quality. The predicted water quality model projected future trends of water quality. The upstream section near Labangan is expected to maintain relatively good conditions, while the water quality in San Roque is projected to improve due to the phytoremediation water treatment. However, the midstream and downstream areas, particularly Barangay 4 and Barangay 5, remain in poor condition.

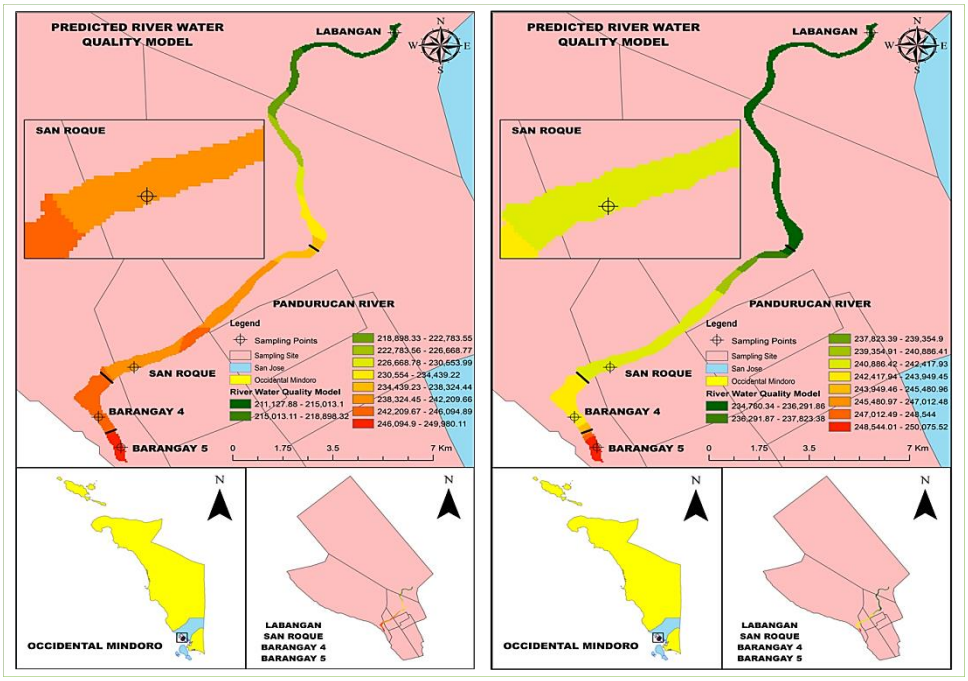

Fig. 5. Water Quality Prediction map of Pandurucan River.

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DISCUSSION

The study revealed the present condition of the Pandurucan River. Water temperature exceeded the allowable range at some stations, particularly in San Roque, where reduced river flow contributed to heat retention (Booker & Whitehead, 2021). The DO levels were generally low, especially in San Roque and Labangan, likely due to limited water flow and anthropogenic pollution (Naubi et al., 2016). High chloride concentrations were recorded in Brgy. V due to saltwater intrusion, which may disrupt freshwater ecosystems. Additionally, elevated phosphate levels in Brgy. Labangan and Brgy. San Roque were linked to agricultural runoff and sewage discharge, reinforcing studies by Mekonnen, M. M., & Hoekstra, A. Y. (2017) on phosphorus pollution in freshwater systems. The computed WQI values for the four sampling stations indicated that all the water samples failed to meet the allowable standards set by the DENR for water quality. The WQI results reflect that all sampling stations exhibit poor water quality, which is consistently threatened and compromised by surrounding environmental factors. Brgy. San Roque recorded the lowest WQI, marking it as the station with the poorest water quality. After installing the water treatment pool in San Roque, water quality parameters improved temperature, pH, TSS, nitrate, and phosphate levels, while chloride remained high. After the statistical analysis of the result, the efficacy of the phytoremediation treatment showed significant improvements, particularly in DO, pH, and temperature, with p-values less than 0.05. However, an increase in chloride levels was observed, which was associated with factors such as wastewater discharge and saltwater intrusion. The improvements in TSS, nitrate, and phosphate concentrations highlighted the effectiveness of aquatic plants in enhancing water quality (Ansari et al., 2020). The phytoremediation treatment in Brgy. San Roque improved water quality, with reduced pollutants in the treated area; however, Brgy. IV and V remain polluted, highlighting the need for further interventions. Future projections show continued improvement in San Roque, but other areas require additional treatments. Moreover, the predicted model was validated using the coefficient of determination. The result revealed that 82% of the variability in water quality shows a strong correlation between the observed and predicted values, which makes the model an excellent tool for forecasting and directing environmental management. The researchers presented the study to the Municipal Environment and Natural Resources Office (MENRO) to increase its reliability. The MENRO recognized the importance of the study in offering crucial information about how phytoremediation works as an economical and environmentally friendly way to enhance water quality. Furthermore, predictive models could be a tool for future environmental decision-making that requires additional interventions and optimizing remediation efforts. The municipality's environmental management plans could benefit significantly from the study to protect aquatic life, improve the water quality, and ensure long-term sustainability.

CONCLUSION

The assessment of the Pandurucan River's water quality showed temperature fluctuations, low dissolved oxygen, high chloride and phosphate levels, and signs of pollution. While the pH, nitrate, and TSS levels remained within acceptable standards, saltwater intrusion and nutrient pollution suggest significant environmental stress. Moreover, all four stations' Water Quality Index (WQI) failed to meet the DENR standards, indicating poor water quality.

Among these four sampling stations, Brgy. San Roque has the lowest WQI, thus highlighting the significant pollution in the area. However, the Solar-Powered Phytoremediation Water Treatment Pool improved key water quality parameters, enhanced dissolved oxygen, pH, and temperature, and reduced TSS, nitrate, phosphate, and chloride levels.

Additionally, the ArcGIS-based water quality model effectively visualized spatial variations, demonstrating significant improvements in all water quality parameters in Brgy. San Roque after phytoremediation. Furthermore, phytoremediation in Brgy. San Roque significantly reduced pollutants, improving water quality in the treated section. However, downstream areas remain polluted, indicating the need for further intervention. The predictive model suggests continued improvements in San Roque and stable conditions in Labangan, but pollution in downstream areas persists. Therefore, expanding treatment efforts is essential for comprehensive river restoration. Lastly, the prediction model accurately captures water quality variations, proving to be a reliable tool for forecasting and environmental management.

To enhance water quality monitoring and management in the Pandurucan River, it is recommended to increase sampling stations for better spatial variability capture and extend monitoring across seasons to understand annual changes. Utilizing remote sensing and GIS modeling can identify pollution-affected areas while expanding assessments to include heavy metals and emerging pollutants will provide a comprehensive view of the river's health. Additionally, implementing multi-tiered treatment systems with salt-tolerant plants can improve phytoremediation, and treatment designs should focus on durability and scalability. Conducting a multifactorial analysis of land use, industrial activities, and meteorological patterns will help pinpoint pollution sources supported by statistical methods to identify significant contributors to water quality degradation. Lastly, analyzing river flow patterns is essential for optimizing treatment efficiency, collectively contributing to the sustainable management of the Pandurucan River.

ACKNOWLEDGEMENT

The researchers would like to express their heartfelt gratitude to all individuals and institutions whose support contributed to the success of this study. Special thanks are extended to the administration, faculty, and research office of Occidental Mindoro State College for their invaluable guidance and assistance throughout the project. The researchers also wish to acknowledge the expert insights and encouragement provided by their adviser, panel members, and mentors. Finally, the researchers are deeply appreciative of the unwavering support and motivation from their families and peers during this research.

REFERENCES

Ansari, A. A., Naeem, M., Gill, S. S., & AlZuaibr, F. M. (2020). Phytoremediation of contaminated waters: An eco-friendly technology based on aquatic macrophytes application. *Egyptian Journal of Aquatic Research, 46*(4), 371–376. https://doi.org/10.1016/j.ejar.2020.03.002

Booker, D. J., & Whitehead, A. L. (2021). River water temperatures are higher during lower flows after accounting for meteorological variability. *River Research and Applications, 38*(1), 3–22. https://doi.org/10.1002/rra.3870

DeepChand, N., Khan, N. A., Saxena, P., & Goyal, S. K. (2022). Assessment of supply water quality using GIS tool for selected locations in Delhi–A case study. *Air Soil and Water Research, 15*. https://doi.org/10.1177/11786221221111935

Enriquez, M. D., & Tanhueco, R. M. (2022). A basis water quality monitoring plan for rehabilitation and protection. *Global Journal of Environmental Science and Management. 8*(2), 227-238. https://doi.org/10.22034/gjesm.2022.02.07

Gorito, A. M., Ribeiro, A. R., Almeida, C., & Silva, A. M. (2017). A review on the application of constructed wetlands for the removal of priority substances and contaminants of emerging concern listed in recently launched EU legislation. *Environmental Pollution, 227*, 428–443. https://doi.org/10.1016/j.envpol.2017.04.060

Md Anawar, H. & Chowdhury, R. (2020). Remediation of Polluted River Water by Biological, Chemical, Ecological and Engineering Processes. *Sustainability 2020, 12*(17), 7017; https://doi.org/10.3390/su12177017

Mekonnen, M. M., & Hoekstra, A. Y. (2017). Global Anthropogenic phosphorus loads to freshwater and associated grey water footprints and water Pollution Levels: A High-Resolution Global Study. *Water Resources Research*, *54*(1), 345–358. https://doi.org/10.1002/2017wr020448

Murray, L. (2021). Globally, 3 billion people at health risk due to scarce data on water quality. *United Nation Environment Programme*. https://www.unep.org/news-and-stories/story/globally-3-billion-people-health-risk-due-scarce-data-water-quality

Muyot, N. (2022). Assessing surface water quality: Physico-chemical properties of the Pandurucan River, San Jose, Mindoro, Philippines. *International Journal of All Research Education and Scientific Methods (IJARESM)*, 10(6). https://www.ijaresm.com/uploaded_files/document_file/Norma_B._Muyot,_FK69.pdf

Naubi, I., Zardari, N. H., Shirazi, S., Ibrahim, F., & Baloo, L. (2016). Effectiveness of Water Quality Index for monitoring Malaysian river water quality. *Polish Journal of Environmental Studies, 25*(1), 231–239. https://doi.org/10.15244/pjoes/60109

Padhye, L. P., Srivastava, P., Jasemizad, T., Bolan, S., Hou, D., Shaheen, S. M., Rinklebe, J., O'Connor, D., Lamb, D., Wang, H., Siddique, K. H., & Bolan, N. (2023). Contaminant containment for sustainable remediation of persistent contaminants in soil and groundwater. *Journal of Hazardous Materials*, *455*, 131575. https://doi.org/10.1016/j.jhazmat.2023.131575

Pang, Y. L., Quek, Y. Y., Lim, S., & Shuit, S. H. (2023). Review on phytoremediation potential of floating aquatic plants for heavy metals: A promising approach. *Sustainability, 15*(2), 1290. https://doi.org/10.3390/su15021290

Philippine Institute for Development Studies. (2024). Quenching Policy Thirst: Reforming Water Governance in the Philippines. *Socioeconomic research Portal for the Philippines.* https://serp-p.pids.gov.ph/publication/public/view?slug=quenching-policy-thirst-reforming-water-governance-in-the-philippines

Priya, A. K., Muruganandam, M., Ali, S. S., & Kornaros, M. (2023). Clean-Up of Heavy Metals from Contaminated Soil by Phytoremediation: A Multidisciplinary and Eco-Friendly Approach. *Toxics*, *11*(5), 422. https://doi.org/10.3390/toxics11050422

Republic Act No. 9275. (2004). The Philippine Clean Water Act of 2004. https://lawphil.net/statutes/repacts/ra2004/ra_9275_2004.html

U.S. Environmental Protection Agency. (2021). Basic Information about Lead in Drinking Water. *US EPA.* https://www.epa.gov/ground-water-and-drinking-water/basic-information-about-lead-drinking-water#:~:text=To%20address%20corrosion%20of%20lead,prevent%20lead%20in%20drinking%20water

Verma, R. K., Sankhla, M. S., Jadhav, E. B., Parihar, K., & Awasthi, K. K. (2021). Phytoremediation of heavy metals extracted from soil and aquatic environments: Current advances as well as emerging trends. *Biointerface Research in Applied Chemistry, 12*(4), 5486–5509. https://doi.org/10.33263/BRIAC124.54865509

Wu, X., Zhang, Q., Wen, F., & Qi, Y. (2022). A water quality prediction model based on multi-task deep learning: A case study of the Yellow River, China. *Water, 14*(21), 3408. https://doi.org/10.3390/w14213408

RESEARCH ARTICLE

INCIDENT VICTIM IDENTIFICATION SYSTEM FOR MUNICIPAL DISASTER RISK REDUCTION AND MANAGEMENT OFFICE (MDRRMO) SABLAYAN

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ABSTRACT

The Incident Victim Identification System (IVIS) for the Municipal Disaster Risk Reduction and Management Office (MDRRMO) Sablayan is a developmental capstone study designed to enhance victim identification efficiency during emergencies. It addresses shortcomings of manual and visual methods, which are error-prone in mass casualty scenarios where victims might be unconscious. IVIS provides a secure, technology-driven platform for precise, rapid, and coordinated disaster response using biometric fingerprint identification. This web-based system features secure user management, role-based access, biometric enrollment and comparison, SMS alert integration, and a centralized dashboard for real-time incident tracking. Authorized users–encoders, responders, and administrators–can enroll residents, compare fingerprints against encrypted templates, and generate official incident reports. It also automates alerts to emergency contacts and produces printable PDF victim summaries. Crucially, IVIS ensures ethical and legal compliance, adhering to the Philippine Data Privacy Act of 2012 by using minutiae-based fingerprint templates instead of raw images. For implementation, IVIS leveraged ASP.NET for the frontend, Laravel for server-side processing, MySQL Server for the database, and SourceAFIS for fingerprint verification. XML was used for structured data exchange, and an integrated SMS API facilitated alert functions. Performance testing on a Windows 11 device indicated average response times of 0.8 to 2.0 seconds, maintaining steady performance under five simultaneous users. Security and scalability tests confirmed the system's stability and data protection capabilities. Evaluations, based on ISO/IEC 25010 Software Quality Standards, involved 60 respondents from the community, MDRRMO, and IT sectors. The system achieved an excellent overall rating of 4.74, with high scores in technology utilization (4.93) and creativity (4.84). These findings validate IVIS's capacity to facilitate quicker, more secure, and efficient victim identification during emergencies in Sablayan.

Keywords: *victim identification, fingerprint biometrics, biometric identification, scanning*

SDG: *SDG 3: Good Health and Well-Being, SDG 11: Sustainable Cities and Communities, SDG 16: Peace, Justice, and Strong Institutions, SGD 17: Partnerships for the Goals*

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INTRODUCTION

An incident is any unplanned event or circumstance that disturbs regular operations and has the potential to inflict harm on individuals, assets, or the surrounding environment. According to the World Health Organization, 1.35 million dies in road accidents each year around the world and around 50 million others are badly injured or affected by traffic crashes (Rosen et al., 2022). Similarly, natural disasters like floods and earthquakes also pose substantial threats to communities, causing widespread destruction.

Accidents and disasters are great causes of concern in the Philippines, thus placing the Municipal Disaster Risk Reduction and Management Offices (MDRRMOs) in a position to lessen this negative impact. In common with most municipalities, Sablayan undergoes a series of common accidents: traffic accidents on its busy roads and working accidents in its industries. Sablayan is also threatened by natural disasters such as typhoons, floods, and landslides, which undermine the safety and security of its residents. One notable

event that must never be forgotten by the disaster group was on March 20, 2018, when a Dimple bus veered off a bridge in Sablayan, Occidental Mindoro, thereby causing many injuries and fatalities and stressing the need for ever-timely medical assistance. Delays occurred just because of the extreme difficulties of identifying corpses; hence, since the delay in giving help, the situation worsened to pain and casualty.

The factoring mechanisms of response thus heavily place initial stress on quick and accurate identification of victims of an accident, especially in instances of mass casualties, to facilitate medical intervention and support in due time. In terms of a timely launch of medical intervention, quick and proper identification is critical for the curtailment of the severity of injuries and of lives saved. Rapid and accurate identification allows the responders to assess aptly the needs of each victim and allocate resources to each victim accordingly. This ensures the medical personnel to be able to provide the right kind of treatment on time, which in turn reduces the chances of complications thereby improving the overall results (Fanca et al., 2018). In essence, timely victim identification is critical for optimizing emergency response efforts and ensuring the well-being of those affected by accidents.

Traditional ways of victim identification, such as manual documentation and visual verification, often prove to be inefficient and prone to errors, especially in mass casualty incidents or situations where victims are unable to communicate due to injury or trauma (Jain, 2024). Presently in Sablayan, the system of alerting the necessary emergency responder in charge is done manually using phone calls and social media postings. When an accident occurs, the onlookers (passer-by) call any of the emergency lines or post the incident on Facebook tagging the page of the MDRRMO informing the officer in charge about the accident and its location. On reaching the accident scene, the emergency responder assesses the severity of the accident, providing first aid if necessary and rush the victim to the hospital for medical attention but the main concern arises when there is difficulty in identifying unconscious victim particularly in cases where there is no identity proof such as identity card, ATM card, or driver's license on them. At times, it's difficult to reach the relatives due to the victim's condition, which may prevent access to their active phone numbers. Consequently, this delay can result in the victim not receiving timely and appropriate medical care.

Taking this into consideration, researchers filled a critical gap by creating and deploying an Incident Victim Identification System integrated with fingerprint recognition technology, tailored for the Municipal Disaster Risk Reduction and Management Office (MDRRMO) in the municipality of Sablayan, Occidental Mindoro. This system was a great achievement in terms of higher portability, speed, and accessibility, with SMS automation added to it. In addition, it has a web application for both user and resident management, as well as for emergency responders, thus ensuring ease and mobility in its usage. Moreover, this system is equipped with SMS automation wherein timely notifications would be sent to victim contacts. This will improve disaster risk reduction and management on the local front.

This study will mainly be intended to develop an Incident Victim Identification System for the Municipal Disaster Risk and Reduction Management Office (MDRRMO) Sablayan to identify victims of incidents in a short time frame and keep track of them accurately. This aims to improve the response time to an incident while enhancing coordination when coming up with plans to address emergencies. The goal of the project is to be able to efficiently gather and update victim information to be able to manage disasters better.

Specifically, this study aims to: 1. Design and develop a web-based platform for emergency responses which is secure and easy to use by people. This is perceptibly because of the secure user management, biometric registration of the residents, and tools for accurate identification of the victims. The system supports real-time incident reporting, sends SMS alerts to designated emergency contacts, and offers a dashboard for monitoring casualty trends and incident data. Role-based access control ensures data privacy and system security. 2. Develop an Incident Victim Identification System using software for the system interface design and functions. The system uses ASP.NET for web application development, MySQL Server for efficient relational data management, and Laravel as the backend framework to handle system operations. SourceAFIS is integrated to enable biometric fingerprint identification, improving the accuracy of victim identification. XML is utilized for structured data handling and exchange, while an SMS API Service allows the system to send real-time alert messages to designated emergency contacts.: 3. test and improve the project in terms of the following characteristics: Functionality, Content, Reliability, Availability, Scalability; and 4. Evaluate the performance of the system using ISO 25010 software evaluation tools and website validator.

METHODS

Research Design

The project development life cycle adopted for this study followed a spiral model. This iterative approach entailed several sequential phases, including defining objectives, identifying and mitigating risks, creating subsequent product versions, and reviewing and planning for upcoming phases. At the outset of each phase, customer requirements were collected, and goals were outlined, detailed, and scrutinized. During this phase, a variety of potential solutions were proposed and assessed

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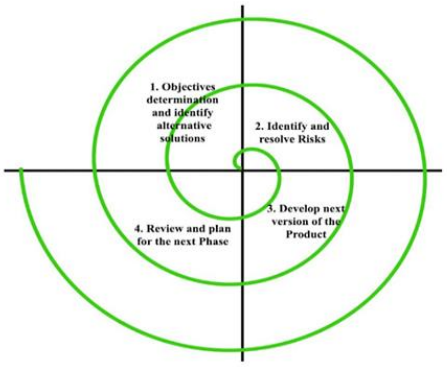

Fig. 1. Software development model of the Incident Victim Identification System.

Research Environment

The research was conducted in collaboration with Municipal Disaster Risk and Reduction Management Office (MDRRMO) Sablayan, focusing on addressing the challenges of traditional way and processes of victim identification, such as manual documentation and visual verification, often prove to be inefficient and prone to errors, especially in mass casualty incidents or situations where victims are unable to communicate due to injury or trauma.

Respondents and Sampling

The primary respondents for this study were include forty-five (45) residents from Barangay Poblacion, Sablayan, Occidental Mindoro, along with five (5) IT experts, five (5) MDRRMO officers, and five (5) Barangay Personnel. Purposive sampling were employed to select respondents from the residence of barangay to minimize bias and purposive sampling to select respondents from the MDRRMO officers, barangay Personnel and IT experts who possess unique knowledge or expertise in the development and implementation of web-based systems, ensuring the system's effectiveness and usability in real-world settings.

System Architecture

Development of the Incident Victim Identification System for the Municipal Disaster Risk and Reduction Management Office (MDRRMO) Sablayan proceeded in a structured and systematic manner to create functionality and access for the eventual user. The first step was defining project objectives and investigating possible alternative solutions. The spiral model was constituted as the life cycle development framework.

It was concerned with a series of iterative phases of goal setting, risk analysis, product generation, and continuous evaluation. Each phase comprised the collection of the client requirements and an in-depth review of goals. Different possibilities were brought forward and analyzed to pinpoint the most suitable one. During the second phase, risks associated with the selected solution were identified and mitigated, culminating in the development of a prototype. The focus of the third stage was the construction of features that were tested and verified to meet user requirements. Once testing was fully complete, the new version of the system was released. The final stage involved the system being visited by stakeholders and collecting their feedback intended for future improvement and planning. This continuous cycle allowed the

system to evolve effectively, ensuring it addressed the needs of its users and achieved its intended purpose.

The development phase involves the actual construction of the system, focusing on the integration of hardware and software components within the system architecture. For the Incident Victim Identification System using fingerprint biometrics, several technologies were utilized to support both the interface and core functionalities. These include Laravel for program logic and system interface design, MySQL Server for efficient database management and updating, and Draw.io for creating system architecture and workflow diagrams. Together, these tools support a reliable architecture designed for accurate and efficient victim identification

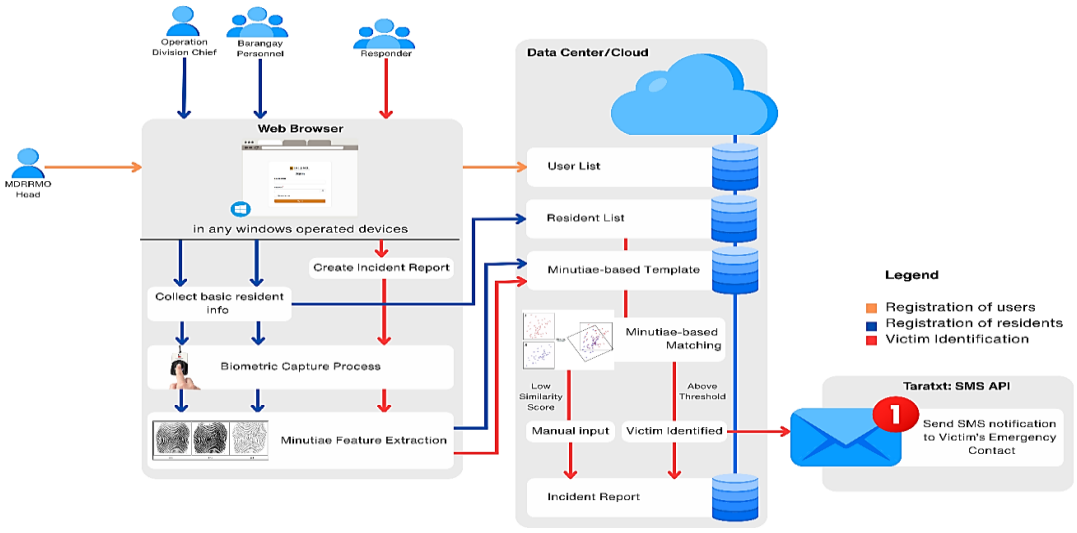

Fig. 2. System Architecture Design.

Figure 3 shows the use case diagram of the system, highlighting its functions through actors and use cases. The Administrator/MDRRMO Head manages users and has full viewing access to resident data and reports. The Secondary Admin/Operation Division Chief can manage residents and access reports, while Barangay Personnel are responsible for updating resident information in their areas. Emergency Responders are tasked with creating incident reports. This process includes scanning the victim's fingerprint to identify them. If a match is found, the system automatically sends an SMS to the victim's registered emergency contact. If no match is found, the responder manually enters the victim's details.

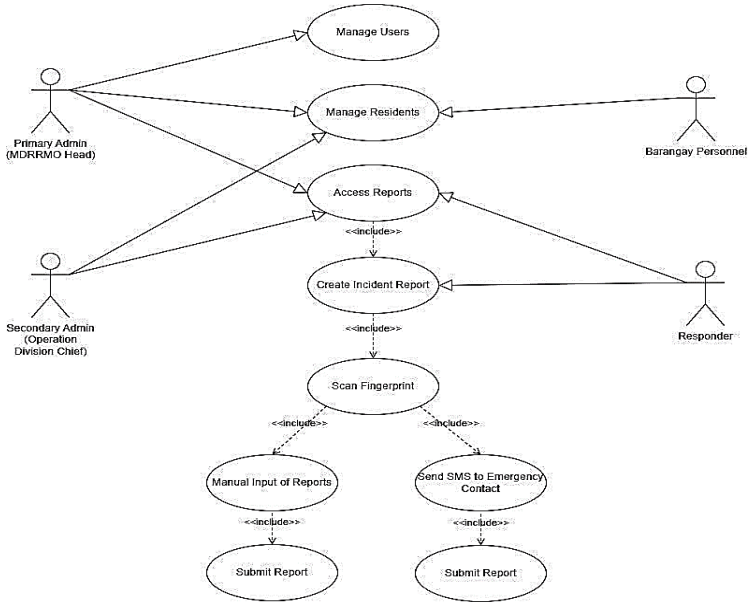

Fig. 3. Use Case diagram of Incident Victim Identification System.

Ethical Considerations

In the implementation of the Incident Victim Identification System (IVISMS) for the MDRRMO Sablayan, strict ethical practices were followed, especially in dealing with biometric information like fingerprints. As per the Data Privacy Act of 2012 (RA 10173), the MDRRMO took full responsibility for all data privacy and ethical concerns. Clear and detailed informed consent forms were made available and distributed during the barangay-level enrollment process, where residents were informed of the purpose, scope, and use of their information. The enrollment remained voluntary, and manual registration alternatives were also made available to those who did not want to enroll biometrically.

To protect privacy and orderly registration, the MDRRMO arranged for coordination with barangay leaders to enable the enrollment process, where privacy notices were explained and well-documented. To institutionalize these processes, the municipal government will endorse a local ordinance that defined data governance policies such as data retention timeframes, access control rules, and prohibitions against abuse of data. Notably, IVISMS aligns with both ethical and legal standards by implementing a minutiae-based fingerprint matching system. Rather than storing actual images of fingerprints, the system extracts key features referred to as minutiae point's unique ridge endings and bifurcations which are converted into encrypted mathematical templates. These templates are not possible to use for the recreation of the original fingerprint image, thus reducing the possibility of identity theft or misuse of biometrics, especially in situations where information could be saved in the cloud.

This privacy-focused approach supports the principle of data minimization under RA 10173 and international frameworks such as the General Data Protection Regulation (GDPR), as it stores only the requisite information needed for identification. Ethically, it demonstrates respect for individual privacy by assuring that biometric information is securely processed and used solely for its intended purpose. Furthermore, a data disposal and retention policy were

implemented, ensuring that biometric information is completely erased after it has been utilized. By integrating these privacy and ethical considerations into the system design as well as into MDRRMO policy, IVISMS effectively safeguards personal rights without diminishing the office's ability to act effectively and responsibly in case of disasters.

Testing and Implementation

Testing was conducted to evaluate the compatibility, efficiency, and performance of the research project's system such as operating systems, web browsers, screen resolution at monitors. System testing would include unit testing, integration testing, and system testing to ensure that components work well during the implementation.

Evaluation, Data Collection and Analysis

The evaluation phase comprised several stages aimed at assessing the overall performance of the research project's system. It began with a preliminary evaluation conducted by the developer, focusing on the expected output of the system. This was followed by the project demonstration, where forty-five (45) selected residents from Barangay Poblacion, Sablayan, Occidental Mindoro, along with five (5) IT experts, five (5) MDRRMO officers, and five (5) Barangay Personnel, were invited to participate. During the demonstration, the system and its functionalities were presented to the attendees, who were then asked to operate the system. The behavior and performance of the system were carefully monitored throughout the demonstration.

In the final evaluation phase, the survey questionnaires were delivered to the respondents, requiring them to assess the system with the provided criteria in the evaluation instrument. They were further requested to offer suggestions and recommendations with the use of a five (5) point Likert scale. This evaluation instrument was then collected for data analysis; means were computed and tabulated for each criterion as well as for an overall mean across all criteria for interpretation. The performance of the system was evaluated based on a five-point Likert scale, with 5 indicating the highest rating and 1 the lowest.

Table 1. Likert-scale. Description and range distribution.

Scale	Descriptive Rating	Range
5	Excellent	4.51-5.50
4	Very Good	3.51-4.50
3	Good	2.51-3.50
2	Fair	1.51-2.50
1	Poor	0.50-1.50

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RESULTS

Project Structure

The Incident Victim Identification System (IVISMS) was created to address problems in manual victim identification, including laborious documentation and inaccurate visual identification in emergency situations. It has an easy-to-use, role-based web interface that allows secure access for Admin, Encoder, and Responder roles, with two-factor authentication for administrators for added security. Biometric information is taken, compared, and preserved through a minutiae-based fingerprint system, which accommodates encrypted templates rather than raw images to keep in line with the Data Privacy Act of 2012 and minimize risk of abuse. Scalability testing demonstrated consistent performance with up to five simultaneous users creating fingerprint scans, lookups, and reporting without system lag. Security testing, such as access control verification and input sanitization checks, uncovered no serious vulnerabilities, confirming its fitness for municipal deployment.

The role-based login screen (Figure 4a) offers secure access to various user levels of Admin, Encoder, and Responder with two-factor authentication for administrative accounts. After logging in, users navigate to the enrolment and fingerprint matching screen (Figure 4b), which enables barangay staff or responders to enroll residents via biometric data and conduct automated matching in the actual event of an emergency. This feature facilitates speedy identification through comparison of captured prints with an encrypted minutiae-based template database. Once a match is found, users can produce official documents through the report creation module (Figure 4c). This functionality aggregates vital information–such as personal data, fingerprint match findings, rescue location, and additional important notes–into a printable PDF report that facilitates field operations and centralized coordination.

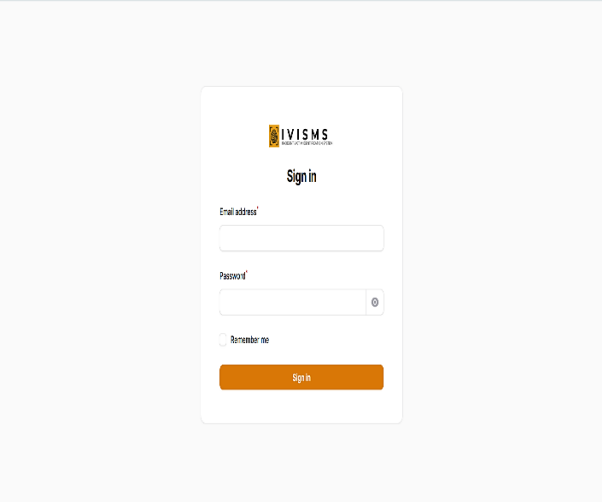

Fig. 4a. Role-based login screen.

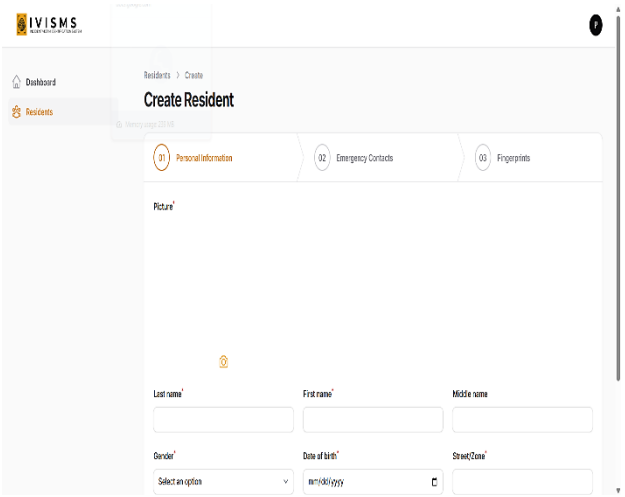

Fig. 4b. Enrolment and fingerprint matching screen.

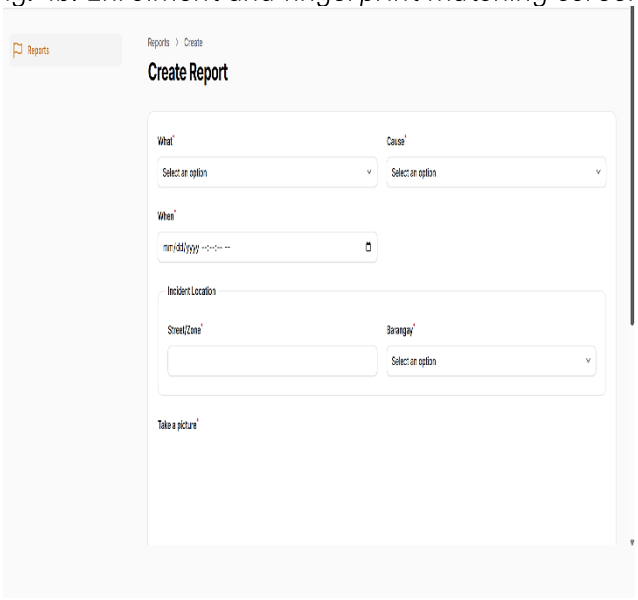

Fig. 4c. Report creation module screen.

Project Testing

The Incident Victim Identification System (IVISMS) performed effectively and consistently when it was tested using a 15-inch 1920×1080 screen laptop powered by Windows 11. The core capabilities of the system–login (0.80–1.20s), fingerprint enrollment (1.50–2.00s), victim identification (1.00–1.30s), and PDF report generation (1.30–1.80s)–all responded within optimal times, even in emergency situations. Fingerprint matching maintained a 98.7% accuracy measure based on testing against a database of 1,000 records. Browser compatibility was checked on Chrome, Firefox, and Edge browsers, with Chrome providing the most seamless experience, though only slight visual variations were present in the other browsers. The interface was responsive at 90%–125% scaling and looked fine on bigger external monitors. Also, simulated access by five (5) simultaneous users certified the capability of the system to serve multiple sessions without degradation of performance. These outcomes validate IVISMS as a rapid, precise, expandable, and browser-supported tool which can be employed under real-life disaster risk reduction operations.

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Project Evaluation

For the evaluation stage of the research project, purposive sampling was used to select respondents that were most relevant to the validation study. Forty-five (45) residents of Barangay Poblacion, Sablayan, Occidental Mindoro, along with five (5) IT experts, five (5) MDRRMO officers, and five (5) Barangay Personnel, were invited to participate in the project demonstration. They were given a survey questionnaire to assess aspects of the system's Web application. The following are the results of the evaluation on the software module of the System.

Based on a five-point Likert scale, the system had a grand mean score of 4.74, which represents an "Excellent" rating in all important aspects. The Technology Used area scored the highest with 4.93, noting high satisfaction with the secure and innovative utilization of fingerprint biometrics by the system. Other categories including Originality (4.84), Content (4.79), and Functionality (4.75) were similarly marked as "Excellent", showing that the system was seen as relevant, simple to use, and useful in actual emergency situations. The Organization and Design category had a slightly lower rating of 4.40, which was categorized under "Very Good". Even though users rated the system interface overall as being well-designed and easy to use, this rating indicates that slight adjustments may be made to layout or visual hierarchy to further optimize overall user experience. These findings affirm the successful adoption of the system and offer direction for further improvement, the theme of which is discussed later.

Table 2: Quantitative interpretation of respondent's rating of Incident Victim Identification System for MDRRMO Sablayan

Criteria	Overall Mean	Descriptive Rating
Content	4.79	Excellent
Organization and design	4.40	Very Good
Functionality	4.75	Excellent
Technology Used	4.93	Excellent
Originality	4.84	Excellent
Grand Mean	**4.74**	**Excellent**

DISCUSSION

Incident Victim Identification System (IVISMS) designed for MDRRMO Sablayan proved effective in overcoming major emergency response challenges, especially victim identification in mass casualties. IVISMS substituted conventional manual and visual verification with a protected, web-based system that employs biometric fingerprint scanning. The system also had a real-time monitoring dashboard and SMS alert system, facilitating quicker coordination in emergencies. These capabilities facilitated faster and more precise victim identification, meeting the main research goal. The easy-to-use interface and organized structure facilitated effective data collection and updating, enhancing disaster response activity significantly (Philippine Council for Health Research and Development, 2022). Notably, traditional methods of manual documentation and visual verification in various industries are recognized as error-prone and inefficient, especially under time constraints and high-pressure conditions. In

healthcare, manual nursing documentation is time-consuming and prone to errors, leading to potential sanctions (Haas et al., 2021). Similarly, in aviation maintenance, human errors due to stressful working conditions pose significant safety risks (De Crescenzio et al., 2011). The complexity of embedded software in critical systems has outpaced traditional verification methods, making them resource-intensive and costly (Beyene & Ruess, 2018). To address these challenges, automated systems are being developed across industries. In medication management, an automated verification system using deep learning has demonstrated high accuracy in drug identification, potentially reducing medication errors and alleviating staff burden (Chiu, 2024).

System testing on various platforms and devices is crucial for ensuring effective performance. Screen size and resolution can impact test scores, with larger high-resolution displays potentially improving verbal performance (Bridgeman et al., 2001). Web system quality depends on factors like functionality, usability, browser compatibility, security, and scalability (Nabil et al., 2011). Windows 11 has shown improved performance in multi-core environments, with faster boot times and better processor workload distribution (Putra et al., 2025). Different web-building platforms, browsers, and operating systems can affect display time and response recording accuracy (Anwyl-Irvine et al., 2020). While modern web platforms generally provide reasonable accuracy for display duration and response time, specific combinations may produce unexpected variances. These findings emphasize the importance of comprehensive testing across various configurations to ensure optimal system performance and user experience.

Recent studies have demonstrated significant advancements in local government information systems in the Philippines. The WeBarangay system achieved excellent usability scores, with a System Usability Scale (SUS) score of 85.50 (Rey, 2024). Similarly, a community-based disaster risk reduction and management system showed high functionality and efficiency, incorporating features like fingerprint biometrics and decision support systems (Goh et al., 2019). Additionally, an enhanced Barangay Information Management System with residency certificate issuance capabilities received high user acceptance ratings, averaging 4.58 on the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire (Dela Cruz et al., 2023). These studies collectively highlight the successful implementation and positive user reception of innovative local government information systems in the Philippines.

The integration of biometric systems in public safety and healthcare raises significant privacy and ethical concerns. To address these issues, various approaches have been proposed. Privacy by Design principles, exemplified by Biometric Encryption, embed privacy protection into system functionality (Cavoukian et al., 2012). Smart Video Surveillance systems can implement privacy-preserving measures through algorithm, system, model, and data design (Ardabili et al., 2022). In healthcare, Privacy-Preserving Distributed Analytics and bioethics committees have been successful in managing privacy and ethical considerations in Health Information Management Systems (Rahman et al., 2024). The development of secure and privacy-compliant techniques in automatic human recognition is ongoing, with a focus on template protection, signal processing in encrypted domains, and standardization (Campisi, 2013). These approaches aim to balance the benefits of biometric technology with the

protection of individual privacy and ethical considerations, ensuring responsible implementation across various sectors.

In general, the research was successful because it designed and tested a system that is technically effective, ethically correct, and functionally efficient for disaster victim identification. The incorporation of biometric identification, real-time monitoring, and secure access adds to enhanced emergency response capacity. The results of evaluation and testing reaffirm that IVISMS is scalable and flexible enough to be field-tested in actual municipal disaster risk reduction operations. Its high ratings in technology and innovation attest to its potential for expanded application in other local government units. In this way, the system not only achieves the research goals but also provides a real model for achieving community disaster resilience

CONCLUSION

The Incident Victim Identification System (IVIS) developed for MDRRMO Sablayan represents a significant innovation in local disaster response and management. By combining biometric identification, real-time dashboards, and secure communication tools, IVIS addresses critical delays in victim recognition and emergency coordination.

Testing confirmed that the system is responsive, scalable, and browser-compatible, while user evaluations rated it highly across functionality, content, and innovation. The ethical use of encrypted fingerprint templates and strict adherence to the Philippine Data Privacy Act further reinforce its reliability and security.

As a replicable model for other municipalities, IVIS demonstrates how digital transformation can improve public safety services. Future enhancements–including mobile integration, offline functionality, and printed victim tagging–can further extend its effectiveness during high-risk events. This project contributes meaningfully to the growing field of technology-driven disaster risk reduction and sets a precedent for ethical, user-centered innovation in public service

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REFERENCES

Anwyl-Irvine, A., Dalmaijer, E. S., Hodges, N., & Evershed, J. K. (2020). Realistic precision and accuracy of online experiment platforms, web browsers, and devices. *Behavior Research Methods*, *53*(4), 1407–1425. https://doi.org/10.3758/s13428-020-01501-5

Ardabili, B. R., Pazho, A. D., Noghre, G. A., Neff, C., Ravindran, A., & Tabkhi, H. (2022). Understanding ethics, privacy, and regulations in smart video surveillance for public safety. *arXiv (Cornell University)*. https://doi.org/10.48550/arxiv.2212.12936

Beyene, T. A., & Ruess, H. (2018). Evidential and continuous integration of software verification tools. In *Lecture notes in computer science* (pp. 679–685). https://doi.org/10.1007/978-3-319-95582-7_45

Bridgeman, B., Lennon, M. L., & Jackenthal, A. (2003). Effects of screen size, screen resolution, and display rate on Computer-Based Test performance. *Applied Measurement in Education*, *16*(3), 191–205. https://doi.org/10.1207/s15324818ame1603_2

Campisi, P. (2013). Security and privacy in biometrics. In *Springer eBooks*. https://doi.org/10.1007/978-1-4471-5230-9

Cavoukian, A., Chibba, M., & Stoianov, A. (2012). Advances in Biometric Encryption: Taking Privacy by Design from Academic Research to Deployment. *Review of Policy Research*, *29*(1), 37–61. https://doi.org/10.1111/j.1541-1338.2011.00537.x

Chiu, Y. (2024). Automated medication verification system (AMVS): System based on edge detection and CNN classification drug on embedded systems. *Heliyon*, *10*(9), e30486. https://doi.org/10.1016/j.heliyon.2024.e30486

Cruz, L. a. D., Balilia, C. J., Abana, E., Pagulayan, L., Mebaña, J., Datul, D. J., & Acoba, J. A. (2023). Enhanced Barangay Information Management System with residency certificate issuance. *2023 IEEE 8th International Conference on Recent Advances and Innovations in Engineering (ICRAIE)*, 1–7. https://doi.org/10.1109/icraie59459.2023.10468134

De Crescenzio, F., Fantini, M., Persiani, F., Di Stefano, L., Azzari, P., & Salti, S. (2010). Augmented reality for aircraft maintenance training and operations support. *IEEE Computer Graphics and Applications*, *31*(1), 96–101. https://doi.org/10.1109/mcg.2011.4

Fanca, A., Puscasiu, A., Folea, S., & Valean, H. (2018). Trauma accident detecting and reporting system. *2022 IEEE International Conference on Automation, Quality and Testing, Robotics (AQTR)*, 1–5. https://doi.org/10.1109/aqtr.2018.8402718

Goh, J. E. E., Goh, M. L. I., & Baccay, M. A. (2019). Community-Based Disaster Risk Reduction and Management Information System in the Philippines. *International Conference on Computational Intelligence and Knowledge Economy (ICCIKE), Dubai, United Arab Emirates, 2019, Pp. 581-586*, 581–586. https://doi.org/10.1109/iccike47802.2019.9004391

Haas, O., Hutzler, M., Egginger, T. H., Maier, A., & Rothgang, E. (2021). Automating Time-Consuming and Error-Prone manual nursing management documentation processes. *CIN Computers Informatics Nursing*, *39*(10), 584–591. https://doi.org/10.1097/cin.0000000000000790

Nabil, D., Mosad, A., & Hefny, H. A. (2011). Web-Based Applications quality factors: A survey and a proposed conceptual model. *Egyptian Informatics Journal*, *12*(3), 211–217. https://doi.org/10.1016/j.eij.2011.09.003

Philippine Council for Health Research and Development. (2022). Lessons from Yolanda: 4 ways to improve the retrieval and identification of bodies in disasters - *Philippine Council for Health Research and Development*. https://www.pchrd.dost.gov.ph/news_and_updates/lessons-from-yolanda-4-ways-to-improve-the-retrieval-and-identification-of-bodies-in-disasters/#:~:text=A%20system%20for%20death%20investigation,DNA%20identifications%20of%20the%20victims.

Putra, A. F., Saputra, N. W. I., & Rilvani, N. E. (2025). Performance optimization on Multi-Core processors and Windows 11 kernel management. *Expert Net.*, *1*(2), 57–60. https://doi.org/10.59923/expertnet.v1i2.301

Rahman, M. A., Jim, M. M. I., Uzzaman, A., & Hasan, M. M. (2024). ADDRESSING PRIVACY AND ETHICAL CONSIDERATIONS IN HEALTH INFORMATION MANAGEMENT SYSTEMS (IMS). *Deleted Journal*, *1*(2), 1–13. https://doi.org/10.62304/ijhm.v1i2.127

Rahman, S., Rahman, M., & Rahman, M. M. (2018). Automated Student Attendance System using Fingerprint Recognition. *Edelweiss Applied Science and Technology*, 90–94. https://doi.org/10.33805/2576.8484.120

Rey, W. (2024). Exploring Usability and User Experience in WeBarangay: A SUS and UEQ analysis. *IEEE Conference Publication | IEEE Xplore.* https://ieeexplore.ieee.org/document/10807936

Rosen, H. E., Bari, I., Paichadze, N., Peden, M., Khayesi, M., Monclús, J., & Hyder, A. A. (2022). Global road safety 2010–18: An analysis of Global Status Reports. *Injury.* https://doi.org/10.1016/j.injury.2022.07.030

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IMPLEMENTING GUIDELINES IN WRITING AND CONDUCTING UNDERGRADUATE AND GRADUATE RESEARCH

I. Requirements before Enrolling Undergraduate Research

1. The student must have passed English 10 or its equivalent (Methods of Research/Technical Writing for BAT) where a research proposal is required and completed (Chapters 1-3).
2. The student must have an adviser of his/her choice or designated by the Research Chair. The adviser has technical knowledge of the research topic the student is pursuing.
3. The student must have successfully defended his/her research proposal before a panel on pre-oral defense.
4. The student reports regularly to his/her adviser for direction and guidance in the conduct of his/ her research.
5. A consultation sheet is secured from the Chair's Office where records of the transaction or consultation with the adviser are reflected for purposes of monitoring and supervision.
6. A certificate of **Ready for pre-oral/final defense** signed by panel member, critic reader, statistician and financial critic must be secured by the students before the pre-oral or final defense.
7. The student must provide panelists copies of the manuscript at least one week before the final defense.

II. Thesis Adviser

1. The student has the option to choose an adviser from the list of advisers provided by the Research Chair. The thesis adviser chosen by the student has technical knowledge regarding the research problem he/she is pursuing. If possible, the adviser and the advisee must have the same field of interest/specialization.
2. The thesis adviser should be a permanent faculty or employee of the Institution, if possible.
3. In cases where students cannot choose an adviser, the Research Chair will designate an adviser based on the adviser/student's specialization/major.
4. In case the student changes his/her adviser for any acceptable reason, a **permit to change adviser** must be secured from the Research Chair. Both the "changed" adviser and the new adviser must affix their signature on the permit.

III. Selection of the Members of the Panel, Data Analyst, Financial Critic, and Critic Reader

1. The student is free to choose at most three members of the panel who have technical knowledge on the research he/she is pursuing, one statistician, one financial critic, and one critic reader.
2. The student selects from the list of panel members, statistician, financial critic, and critic reader provided by the Research Chair.

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IV. Role of a Thesis Adviser

1. The adviser is a faculty member of the Academic Department who provides guidance and direction, encouragement, and motivation to his/her advisee in the process of thesis writing.
2. He/she recommends the manuscript for oral defense and signs a particular form for this purpose. The adviser sees to it that his/her advisee is prepared for the oral defense.
3. He/she guides and briefs the advisee on the mechanics of oral defense and prepares him/her on what to expect during the proceeding.
4. He/she must be present during the oral defense but should refrain from answering questions for the advisee or negate views of the members of the panel. He/She may clarify or simplify questions for the advisee and take down notes on suggestions and recommendations.
5. He/she makes concrete suggestions and acts promptly and wisely on parts of the manuscript which require correction or revision. He/She sees to it that his/her advisee follows the prescribed format in writing the manuscript.
6. He/she monitors the progress of the research work of his/her advisee. Members of the panel should also help the adviser in ensuring that the advisee does what is expected of him/her.
7. He/she certifies the approval of the final manuscript.

V. Role of the Members of the Panel

1. The panel members assess the research papers and give comments, suggestions, and recommendations for the improvement of the research paper.
2. They may approve/disapprove the research proposal. Disapproved paper means it has not satisfactorily met the basic requirements of a good research paper.
3. They help monitor the student's research work in coordination with his/her adviser.
4. They evaluate and rate the paper using standard criteria as part of the computation of final grade in Methods of Research or Thesis Writing.
5. They certify the approval of the final manuscript.

VI. Role of a RECO Member

1. The RECO member is a staff of R&D Unit/representative from the pool of experts and is duly designated by the R&D Director.
2. The RECO member is a regular member of the panel during the pre-oral and final defense. He/She informs the new trends in research undertakings.
3. He/she helps monitor the student's research work in coordination with his/her adviser.
4. He/she evaluates and rates the paper using standard criteria as part of the computation of final grade in Methods of Research or Thesis Writing.
5. He/she endorses a student's research proposal for possible funding in the R&D Unit.
6. He/she certifies the approval of the final manuscript.

VII. Role of a Statistician

1. The statistician guides the student in the use of appropriate statistical tools for his/her research paper.

2. He/she gives advice in data encoding and interpretation of the research results.
3. He/she certifies the correctness of the methodology and statistics used in the research manuscript.

VIII. Role of a Critic Reader

1. The critic reader must proofread the manuscript.
2. He/she certifies the correctness in the writing of the manuscript.

IX. Role of a Research Chair

1. The Research Chair helps in implementing policies on the conduct of thesis research paper.
2. He/she prepares the schedule of the pre-oral and final defense.
3. He/she certifies the approval of oral defense of the students.
4. He/she acts as the Chair of the research panel.
5. He/she performs research monitoring in coordination with the adviser.
6. He/she consolidates the evaluation sheets as a basis of grade or rating of the students.
7. He/she certifies the approval of the final manuscript.

X. Requirements for Oral Defense

1. The student must have a written recommendation from his/her thesis adviser in terms of his/her readiness/preparedness for the oral defense.
2. The student must have a certification from the Statistician/Financial Critic as to the approval of statistical/financial requirements of his/her paper.
3. The student must have a certification from a critic reader as to the appropriate grammar and language use.
4. The student must likewise have an approval from the Methods of Research Instructor and Department Chair prior to his/her oral defense.
5. Required copies of the research papers should be submitted at the Research Office with the adviser's certification at least one week before the scheduled defense.
6. The students who failed to defend his/her thesis on schedule will not be allowed to conduct off-campus practice teaching and will not be included in the list of graduating students.

XI. Decorum in the Conduct of Oral Defense

1. The student must be in proper attire.
2. The members of the panel must be in semi-formal or formal attire during oral presentation.
3. The audience must observe silence throughout the presentation.

XII. Submission Procedures

1. Students who failed to defend his/her thesis on schedule will only be allowed to conduct OJT/RLE activities within OMSC Offices/Department/Unit.

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2. The deadline for submission of loose-leaf theses and is at least one workweek before the last day for the submission of grades for graduating students to provide sufficient time for binding. For example, if the deadline for submission of grades is May 7, theses must be approved for binding before April 30.
3. Undergraduate theses must be hardbound using green leatherette with gold lettering.
4. To facilitate future open-access repository, digital copy of theses must be submitted to the College Research Coordinator for safe keeping. With file name: College_Year of Graduation_Last Name of the First Author_Title of Thesis
   Example: CTE_2023_Dela Cruz_Case Study of Occidental Mindoro State College
5. An undergraduate student should submit the following to the College: Four hardbound copy for the department, library, adviser, and student. One digital copy (in PDF with scanned copy of the signed documents) for the department.
6. Addition of Permission Page (Republic Act No. 8293 - Intellectual Property Code of the Philippines). Theses will be classified into one of only four categories:
   - I: has patentable or registrable invention or registration
   - P: author wishes to publish the work personally
   - C: confidential information of a third party is embedded
   - R: a regular work, i.e., it has no patentable invention or creation, the author does not wish for personal publication, there is no confidential information.

XIII. Contents

CHAPTER I: INTRODUCTION
- Background of the Study
- Objectives of the Study
- Significance of the Study

CHAPTER II: REVIEW OF RELATED LITERATURES
- Related Literature
- Theoretical Framework
- Conceptual Framework
- Operational Definition
- Hypothesis/Assumptions

CHAPTER III: RESEARCH METHODOLOGY
- Study Design
- Study Setting – This may be applicable only to some studies.
- Unit of Analysis and Sampling
- Research Instrument
- Data Collection Procedure
- Data Processing and Analysis
- Scope and Limitations
- Ethical Considerations

CHAPTER 4: RESULTS AND DISCUSSION
- Results
- Discussion

CHAPTER V: CONCLUSIONS AND RECOMMENDATIONS
- Conclusion
- Recommendation

REFERENCES

APPENDIX (categorized as A,B,C etc.)

A. Communication/Permit to Conduct the Study
B. Research Instrument Use Permission
C. Research Instruments
D. Pictures/Plates
E. Originality Report
F. Researcher's Profile

Effectivity: starting First Semester, Academic Year 2023-2024

OCCIDENTAL MINDORO STATE COLLEGE
Research and Development

Vision

Globally competitive and sustained socio-economic growth through relevant and responsible R&D.

Mission

Committed to generate and develop technologies that contribute to achieving inclusive growth, food security, and environmental sustainability.

Quality Objectives

1. Generate relevant and innovative research to achieve sustainable development.
2. Communicate research findings to the target beneficiaries.
3. Publish quality research outputs protected by IP laws.

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