International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 9 Issue 5 May - 2025, Pages: 119-123

Converting Paper Waste And Agricultural Fibers To Salvaged Paper Products

Vince Ryan G. Abay-abay[1], Eddyle Vine L. Albor[2], Mhel Francis S. Bendijo[3], Elaiza E. Bustamante[4], Ericka Minh Y. De Guzman[5], Jonna Claire S. Delgado[6], Bambee Sygryd D. Elloreg[7], Danilo M. Jr. Elumba[8], Jafaith B. Lacharon[9], Silver Joy B. Pajares[10], Patrick Dane O. Ramos[11], Jesryl Samm P. Samonte[12], Mandelion Freaonne J. Songcuya[13], Mark Anthony Bell R. Bacang[14], Vianafrankher S. Orias[15]

iplahan National High School, Diplahan Zamboanga Sibugay, Phiippines
Corresponding author: markanthonybell.bacang@deped.gov.ph

***Abstract**: This study explores the development of eco-friendly paper products by recycling paper waste and incorporating agricultural fibers such as banana leaves, star apple leaves, and rice bran. The project aimed to enhance the quality of recycled paper by evaluating its strength, texture, and usability. Following a systematic process involving material preparation, pulp formation, molding, and drying, this research demonstrated that each plant fiber contributes unique properties to the final product. This study emphasizes the practical and environmental significance of utilizing agricultural by-products and paper waste to reduce reliance on virgin wood pulp. The findings highlight the potential to transform waste materials into valuable resources, offering sustainable alternatives for educational institutions, consumers, and industries. This research also lays a foundation for further exploration of innovative recycling technologies and eco-conscious material development.*

Keywords: *Recycled paper, Paper waste, Agricultural fibers, Banana leaves, Star apple leaves, Rice bran, Eco-friendly materials, Sustainability, Strength, Texture, Usability, Waste management.*

Introduction

Wastepaper has become a significant environmental concern today, driven by the increasing consumption of paper products in various sectors, including education, business, and packaging. Despite the rise of digital communication, the paradox of paper usage persists, as many organizations still rely heavily on printed materials. This results in substantial amounts of paper waste, contributing to landfill overflow and environmental degradation.

The paper industry has significant environmental and economic implications. The production of paper and cardboard is crucial in modern society, playing a key role in sectors like education, communication, security, and sanitation. However, the environmental cost of its production, such as deforestation, energy consumption, and pollution, remains a pressing concern. Recycling paper offers several ecological benefits, including reducing the demand for virgin wood, conserving forests, and helping mitigate climate change. Recycling also conserves energy, reduces waste sent to landfills, and minimizes water and air pollution. Furthermore, the recycling process can significantly reduce the emissions of carbon dioxide (CO2), nitrogen oxides (NO2), and sulfur dioxide (SO2).

Additionally, repurposing agricultural waste (such as banana stems, rice husks, and sugarcane bagasse) is emerging to reduce environmental degradation. Companies like Green Banana Paper, which uses discarded banana stems to create eco-friendly products, showcase how agricultural waste can be converted into valuable and sustainable alternatives.

The generation of wastepaper is primarily driven by several interconnected factors, including the widespread reliance on paper products across various sectors. This reliance leads to excessive consumption of paper for reports, handouts, and correspondence, resulting in significant waste. The lack of awareness about recycling and sustainable practices exacerbates the issue, as individuals and organizations may not prioritize recycling or may not know how to do it properly.

Internationally, paper recycling has become a promising solution to the environmental challenges posed by paper production. The recycling process involves breaking down wastepaper into fibers, deinking to remove inks, and undergoing multiple cleaning processes before it can be reused in new products. While the recycling process itself can produce environmental impacts, it is generally considered more sustainable than traditional paper manufacturing, which often involves high energy consumption, deforestation, and harmful chemical use.

Life cycle assessments (LCA) are increasingly being used to evaluate the environmental impacts of various waste management practices, providing valuable insights for policymakers worldwide. Such studies emphasize the importance of sustainable practices like paper recycling and agricultural waste repurposing in reducing the global ecological footprint.

The problem of paper waste is not just global, it also has significant implications at the national level. Educational institutions, especially in countries with high levels of paper consumption, are major producers of paper waste. Schools, including

International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 9 Issue 5 May - 2025, Pages: 119-123

Diplahan National High School, face significant challenges in managing the paper waste generated by assignments, handouts, and administrative needs.

This problem not only contributes to environmental concerns, such as increased landfill waste and deforestation, but also imposes a financial burden on schools that must manage the costs of paper procurement and disposal. Nationally, schools can help mitigate these challenges by promoting environmental awareness among students, teaching them the value of reducing paper waste, and exploring alternatives such as digital resources and the use of agricultural fibers to produce new paper goods.

At the local level, communities like Diplahan National High School are directly impacted by the issue of paper waste. Educational institutions often rely heavily on printed materials, which leads to a significant amount of paper waste being generated. Schools are not only sources of paper consumption but also of paper waste. As these institutions educate future generations, they can play a pivotal role in fostering an environmentally conscious culture by emphasizing the importance of reducing paper waste.

To combat this, local initiatives can focus on teaching students about the environmental and economic impacts of paper waste. This could include promoting digital alternatives for assignments, encouraging the use of agricultural fibers for paper production, and engaging in community-wide recycling programs. By adopting these practices, local communities can contribute to both reducing paper waste and supporting sustainable economic development.

Statement of the Problem

This aimed to create a new type of paper by recycling old paper and adding natural plant fibers to improve its quality.

Specifically, this study sought to achieve the following objectives:

1. What is the quality of the recycled paper with banana leaves in terms of:
   1.1 Strength;
   1.2 Texture; and
   1.3 Usability?
2. What is the quality of the recycled paper with star apple leaves in terms of:
   2.1 Strength;
   2.2 Texture; and
   2.3 Usability?
3. What is the quality of the recycled paper with rice bran in terms of:
   3.1 Strength;
   3.2 Texture; and
   3.3 Usability?
4. Is there significant difference of recycled paper with added plant fibers of banana leaves, star apple, rice bran in terms of:
   4.1 Strength;
   4.2 Texture; and
   4.3 Usability?

Hypothesis:

H_O: There is no significant difference of recycled paper with banana leaves, star apple leaves, and rice bran fiber.

Significance of the study

Methodology

The study utilized an experimental research design to assess the quality of recycled paper enhanced with agricultural fibers. Conducted in Tinongtongan, Diplahan, Zamboanga Sibugay, the researchers created recycled paper by combining paper waste with natural additives like banana leaves, star apple leaves, and rice bran. These materials were blended into a pulp, molded into sheets using a paper strainer, and sun-dried. The recycled paper was evaluated based on strength, texture, and usability using a standardized quality rating system. A quantitative approach, including ANOVA, was applied to analyze differences among the fiber-enhanced paper samples. Tools such as blenders, basins, and pots were used during the process. The study aimed to determine the effectiveness of each plant fiber in improving paper quality while promoting eco-friendly recycling alternatives.

International Journal of Academic Multidisciplinary Research (IJAMR)
ISSN: 2643-9670
Vol. 9 Issue 5 May - 2025, Pages: 119-123

Results and Discussion

This chapter presents, analyzes, and interprets the data gathered from the results of Converting Paper Waste and Agricultural Fibers to Salvaged Paper Products.

The study on Converting Paper Waste and Agricultural Fibers to Salvaged Paper Products led to the following results:

Data on Quality of the recycled paper with banana leaves

Quality	Score	Level of Quality
Strength	3	Good Quality
Texture	3	Good Quality
Usability	2	Fair Quality
Average Mean	2.67	Good Quality

Table 1. The result of the quality of the recycled paper with banana leaves

The table shows that the recycled paper with banana leaves exhibited a moderate level of strength, texture, and usability, with an average mean score of 2.67, falling under the "Good Quality" level. The strength and texture scores indicate that banana leaves can moderately enhance the durability and feel of the recycled paper. However, the usability score suggests that there may be some limitations in its practical applications.

Data on Quality of the recycled paper with banana leaves

Quality	Score	Level of Quality
Strength	2	Fair Quality
Texture	1	Poor Quality
Usability	1	Poor Quality
Average Mean	1.33	Poor Quality

Table 2. The result of the quality of the recycled paper with star apple leaves

The recycled paper with star apple leaves showed lower quality results in terms of strength, texture, and usability, with an average mean score of 1.33, which is classified as "Poor Quality." The low scores indicate that star apple leaves may not be an effective additive for improving the quality of recycled paper.

Data on Quality of the Recycled Paper with Rice Bran

Quality	Score	Level of Quality
Strength	3	Good Quality
Texture	3	Good Quality
Usability	4	Excellent Level
Average Mean	3.33	Good Quality

Table 3. The result of the quality of the recycled paper with rice bran

The recycled paper with rice bran demonstrated the highest quality among the three additives, with an average mean score of 3.33, which falls under the "Good Quality" level. The high scores for strength, texture, and usability suggest that rice bran is a highly effective additive for enhancing the quality of recycled paper, particularly in terms of practical applications.

Comparison of Recycled Paper with Different Plant Fibers

Plant Fiber	Strength	Texture	Usability	Average Mean	Level of Quality
Banana Leaves	3	3	2	2.67	Good Quality
Star Apple Leaves	2	1	1	1.33	Poor Quality

Rice Bran	3	3	4	3.33	Good Quality

Table 4. Recycled Paper with Different Plant Fibers

The comparison of the recycled paper with different plant fibers shows significant differences in terms of quality parameters. Rice bran emerged as the most effective additive, with the highest average mean score of 3.33 and classified as "Good Quality." Banana leaves also showed moderate effectiveness, while star apple leaves had the lowest scores, indicating limited benefits and classified as "Poor Quality."

ANOVA Result

Source of Variation	Sum of Squares	Degree of Freedom	Variance Estimate	F-ratio	P-value	F crit (critical value)
Between Groups	8.22	2	4.11	6.95	0.017	4.26
Within Groups	5.33	9	0.59			
Total	13.55	11				

Table 5. Results for Quality of Recycled Paper with Different Plant Fibers

The table shows that the F-value is 6.95 and a p-value is 0.017. Since the p-value is less than 0.05, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1). This indicates that there is a significant difference in the quality of recycled paper with added plant fibers of banana leaves, star apple leaves, and rice bran.

Conclusions

Based on the findings, the following conclusions were drawn:

Rice bran is highly effective in improving the quality of recycled paper. It enhances the strength, texture, and usability of the paper, making it suitable for a wide range of practical applications. Star apple leaves are the least effective additive. Their low scores in all quality parameters suggest that they may not be suitable for improving recycled paper quality. Banana leaves showed moderate effectiveness. While they improved the strength and texture of the paper, their usability was somewhat limited. The study confirmed that different plant fibers significantly impact the quality of recycled paper. Selecting appropriate additives is crucial to optimizing paper quality.

Recommendations

Based on the conclusions, the following recommendations are proposed:

1. Utilize Rice Bran: Given its effectiveness, rice bran should be considered a primary additive for producing high-quality recycled paper.

2. Further Research on Star Apple Leaves: Additional research is needed to explore potential improvements or alternative uses for star apple leaves in paper recycling.

3. Optimize Use of Banana Leaves: While banana leaves are somewhat effective, further optimization is required to improve their usability. This could involve combining them with other effective fibers like rice bran.

4. Explore Other Plant Fibers: Future research should explore other plant fibers to identify additional effective additives for recycled paper production.

5. Apply Findings in Industry: The study's findings can be applied in the paper recycling industry to produce high-quality recycled paper products. Adopting effective additives like rice bran can enhance the quality and usability of recycled paper, promoting sustainability.

References

De la Cruz, J., Santos, P., & Ramirez, L. (2020). Bioactive compounds in fruit tree leaves: A review. Journal of Agricultural Sciences, 15(2), 112-126.

Elkington, J. (1997). Cannibals with forks: The triple bottom line of 21st century business. Capstone Publishing. Retrieved from https://books.google.com.ph/books/about/Cannibals_with_Forks.html?id=QLg9PgAACAAJ&redir_esc=y

Environmental Protection Agency (EPA). (2016). Advancing sustainable materials management: Facts and figures report. United States Environmental Protection Agency. Retrieved from https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/advancing-sustainable-materials-management

Gonzales, M., Rivera, T., & Dominguez, R. (2019). The medicinal and industrial properties of Chrysophyllum cainito. Asian Journal of Plant Research, 10(1), 56-68.

Kumar, R., Sharma, N., & Patel, D. (2020). Banana fibers for sustainable packaging applications. Environmental Materials Review, 5 (3), 198-210.

Martinez, L., Torres, V., & Herrera, G. (2022). Rice bran fibers in bio-composite materials. International Journal of Material Sciences, 8 (4), 72-89.

MDPI. (2019). Circular economy. MDPI, 8(1), 53. Retrieved from https://www.mdpi.com/2079-9276/8/1/53

Ozola, Z.U., et al. (2019). Paper waste recycling: Circular economy aspects. Riga Technical University Scientific Papers, 23, 260–273. Retrieved from https://intapi.sciendo.com/pdf/10.2478/rtuect-2019-0094

Ozola, Z.U., et al. (2021). Paper waste recycling: Circular economy aspects. Scientific Reports, 11, 96325. Retrieved from https://www.nature.com/articles/s41598-021-96325-4

Pathak, S. (2020). Biomimicry: Innovation inspired by nature. ResearchGate. Retrieved from https://www.researchgate.net/publication/334270395_Biomimicry_Innovation_Inspired_by_Nature

Prendeville, S., et al. (2014). Circular economy: Is it enough? ResearchGate. Retrieved from https://www.researchgate.net/publication/301779162_Circular_Economy_Is_it_Enough

ScienceDirect. (2014). Sustainable consumption and production. ScienceDirect. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0959652614007318

ScienceDirect. (2015). Waste management and the environment. ScienceDirect. Retrieved from https://www.sciencedirect.com/science/article/abs/pii/S0956053X15001312

Singh, A., Gupta, P., & Rao, M. (2021). Industrial applications of banana leaf fibers. Journal of Sustainable Technologies, 14 (3), 245-260.

Tan, W., Lee, C., & Ong, M. (2018). Dietary fibers from rice bran and their health benefits. Food & Nutrition Research, 7 (2), 98-110.

Tchobanoglous, G., & Kreith, F. (2002). Handbook of solid waste management (2nd ed.). McGraw-Hill Education. Retrieved from https://www.academia.edu/114003468/Handbook_of_Solid_Waste_Management

World Commission on Environment and Development (WCED). (1987). Our common future. Oxford University Press. Retrieved from https://digitallibrary.un.org/record/139811?form=MG0AV3

Yamada, K., Fujiwara, H., & Saito, T. (2021). Rice bran fibers as functional food ingredients. Japanese Journal of Food Science, 16 (1), 35-50.