IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

Design and Development of Bio Cups from Agricultural Waste

Prof. Rahul Sheri[1], Amarnath Hanji[2], Atharava Khasbag[3], Sameer Nalaband[4], Vijaykumar Sidnal[5]
Asst. Professor, Department of Mechanical Engineering[1]
Students, Department of Mechanical Engineering[2-5]
Angadi Institute of Technology and Management, Belagavi

Abstract: *This assignment is primarily based at the layout and assembly of air operated cup making gadget. Essentially this undertaking is to don't forget the modern-day problem of expensive gadget for making computer-controlled cups used in the modern industries. Paper cups specifically include plastic. Plastic is a very risky substance in nature and in living things. With the help of this mechanical system cups are fabricated from paper, and the leaves are also used to make cups. After discovering how the present day system makes cups, we came up with an inexpensive answer for generating cups and bowls. This size of cup making machine is loose to match everywhere and is very cost-efficient as properly. In this gadget we use simple strategies to enhance the efficiency of our undertaking. Punch making plans and die are used for the actual making of a cup.*

Keywords: Waste

I. INTRODUCTION

This assignment is primarily based at the layout and assembly of air operated cup making gadget. Essentially this undertaking is to don't forget the modern-day problem of expensive gadget for making computer-controlled cups used in the modern industries. Paper cups specifically include plastic. Plastic is a very risky substance in nature and in living things. With the help of this mechanical system cups are fabricated from paper, and the leaves are also used to make cups. After discovering how the present day system makes cups, we came up with an inexpensive answer for generating cups and bowls. This size of cup making machine is loose to match everywhere and is very cost-efficient as properly. In this gadget we use simple strategies to enhance the efficiency of our undertaking. Punch making plans and die are used for the actual making of a cup. The cylinder and directing control valve is presents to punch the cup and then heating coil is on due to which the cup is done Eco friendly cup the raw material used for making this cup is corn cover which is wasted and burned which is ecofriendly and can solve the problem of plastic and paper. We have kept the mechanism simple the pressing attachment which consists of cylinder and valve which will do the pressing operation, heating attachment, die.

With the growing popularity of sustainability, many companies have begun using environmentally friendly materials. This is particularly significant for the disposable tableware market. Most plastic utensils, paper plates, and styro foam carrying containers are used once for a few hours and then left in a landfill for hundreds of years before they degrade. Efforts have been made in recent years to create single-use tableware that biodegrades in a shorter time frame. Despite their widespread use, single-use cups have not received an environmentally conscious upgrade. This project focused on creating a fully biodegradable single-use cup. The final product consists of agar, hemp, and other natural ingredients coated with wax. This report presents the production process of the product as well as an overview of the engineering design that utilized an axiomatic design process to develop the product. Additionally, a series of experimental tests are outlined that demonstrate that the product has potential to become comparable to other similar products on the market. Furthermore, a financial and market analysis was conducted to display the single-use cup industry and a biodegradable cup's place in it. The creation of this fully biodegradable cup makes further strides in the ever-present goal of developing sustainable single-use tableware and has applications beyond the initial goal. [1]

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

Corn has been a staple food for many cultures for thousands of years and is consumed directly by humans when boiled or fried, use as animal feed and processed products like corn-starch. Corn-strach is given special prominence because is a widely used ingredient in the food industry for its thickening and stabilizing properties. Corn- starch is typically processed manually, starting with soaking of the corn, followed by wet- milling of the fermented product to soften it. The softened product is then shifted to separate the nutrient from the chaff, with the nutrient collected through decantation. The quality of the final product is greatly influenced by the grinding and sifting processes, which impacts the nutritional content of the product for human consumption. The manual method, as elucidated by has been characterized as a labour-intensive, tedious, and unsanitary process. Studies have unveiled that a substantial quantity of nutrients is lost during the processing, and the arduous technique contributes to reduction in its taste profile. However, grinding and sieving of dry products have evolved from traditional mechanical techniques to advanced approaches, there is a noticeable dearth of attention directed towards mechanizing sieving wet agricultural food products on a modest scale for home use considering its high demand. Most of extraction machines for processing corn-starch were designed for industrial use without consideration of rural dwellers who do not have access to industrial machines. Despite the availability of corn-starch machines, many small and medium scale productions in developing economies still use the traditional method due to economic reasons. In Nigeria corn-starch has played a vital role in ensuring meal sufficiency for human population, average Nigerians take pap on a daily basis, unlike rice. Corn-starch is considered a highly nutritious food that is rich in vitamins, lipids, oils, protein, and carbohydrates. [2]

Bio cups made from agricultural waste are an innovative solution aimed at reducing plastic waste and promoting sustainability. These cups are produced using natural, renewable materials derived from agricultural byproducts such as sugarcane, corn, or wheat straw. By utilizing waste that would otherwise be discarded, bio cups help reduce the environmental impact of traditional plastic products. The production of bio cups also supports circular economies by transforming agricultural residues into valuable, biodegradable products, making them an eco-friendly alternative to conventional disposable cups. These cups are compostable and break down more easily, contributing to waste reduction and a cleaner environment. Bio cups made from agricultural waste are an innovative solution to the environmental problems caused by single-use plastic cups. These cups are created using plant-based materials that would otherwise be discarded as agricultural waste. Common raw materials include sugarcane bagasse (the fibrous residue left after sugar extraction), wheat bran, rice husks, corn starch, and even coconut shells. These materials are processed into pulp and molded into cup shapes, which are then treated to make them resistant to liquids, ensuring they can hold beverages without leaking.

The use of agricultural waste for bio cup production also helps to reduce reliance on fossil fuels. Traditional plastic cups are made from petrochemicals, which require significant energy and resources to produce. In contrast, bio cups are made from renewable, plant-based resources that absorb carbon dioxide during their growth, making them a more sustainable choice overall. Additionally, because bio cups are made from waste materials that would otherwise have little value, they offer an opportunity to turn a problem (agricultural waste) into a solution, contributing to the reduction of greenhouse gas emissions. Bio cups also promote a circular economy by encouraging the reuse of materials in the production process. The materials used in bio cup manufacturing can often be sourced locally, reducing transportation emissions and supporting local economies. Moreover, as demand for eco-friendly products grows, the adoption of bio cups helps drive innovation in sustainable manufacturing practices, leading to further reductions in environmental impacts.

In essence, bio cups made from agricultural waste present a comprehensive solution to the pressing issue of plastic pollution, while also addressing waste management problems in the agricultural sector. By replacing conventional plastic cups with bio cups, industries can significantly reduce their carbon footprint, contribute to environmental conservation, and support a more sustainable and circular economy. In summary, bio cups made from agricultural waste offer a promising, eco-conscious alternative to traditional disposable cups, helping reduce plastic pollution, manage agricultural byproducts efficiently, and promote sustainability in both manufacturing and waste management.

In conclusion, bio cups made from agricultural waste offer a multi-faceted solution to pressing global challenges, including plastic pollution, waste management, and sustainable agriculture. Their biodegradable and compostable nature, along with the use of renewable resources, positions them as a key player in the transition to a more sustainable

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

future. With growing awareness and demand for eco-friendly alternatives, bio cups are poised to become a mainstream product, making a significant impact on reducing plastic consumption and promoting environmental responsibility across various sectors. [5]

II. LITERATURE REVIEW

[1] Wang et al. (2022) explored the pulp and molding process for bio cups made from agricultural fibers. Their research found that blending these fibers with biopolymers like PLA (Polylactic Acid) enhances the durability and resistance of the cups. This combination improves the functional properties of the cups, making them stronger and more resilient, while still being biodegradable. Their findings highlight the potential for creating high- performance, eco-friendly alternatives to traditional plastic cups, contributing to more sustainable packaging solutions.

[2] Kumar A & Patel N. (2021) titled "Development of sustainable bio cups from agricultural waste: Challenges and opportunities," published in Sustainable Materials and Technologies, examines the challenges and opportunities in creating bio cups from agricultural waste. The study addresses key issues such as the high cost of production, material performance (strength, water resistance), and the scalability of manufacturing processes. The authors emphasize the potential of bio cups to replace plastic cups, offering a more sustainable alternative. They discuss advancements that could overcome these challenges, such as improved processing techniques and the use of biopolymers, ultimately enabling large-scale adoption and contributing to reducing plastic waste.

[3] Jha et al. (2021) reviewed the potential of agricultural waste, such as rice husks, sugarcane bagasse, and corn stover, for producing bio composites. They found that these materials are not just suitable for bio cups but can also be used in a variety of eco-friendly packaging applications. This approach offers a sustainable alternative to conventional plastic packaging by reducing waste and promoting the use of renewable resources. It aligns with the growing demand for biodegradable and environmentally friendly materials, offering both environmental and economic benefits.

[4] Singh and Ranjan (2021) explored how bio cups made from agricultural waste can play a key role in advancing circular economies. By using agricultural residues like rice husks, sugarcane bagasse, and corn stover, these cups help divert waste from landfills and transform it into eco-friendly products. This process encourages sustainable farming practices, as it creates an incentive to repurpose agricultural by-products rather than burning or discarding them. Additionally, bio cups provide a biodegradable alternative to traditional plastics, which helps reduce long-term pollution. Their study highlights how integrating waste into productive cycles can reduce resource consumption and promote environmental stewardship, creating economic and ecological benefits in a more circular, sustainable economy.

[5] Duan et al. (2021) highlighted key limitations of bio cups, particularly in terms of mechanical strength and water resistance, which can affect their performance in certain applications. To address these issues, their study explored improving the properties of bio cups through composite formulations. By blending agricultural fibers with biopolymers like PLA (Polylactic Acid) or starch, they found that the bio cups could achieve enhanced durability, better water resistance, and greater structural integrity. These composite materials offer a promising solution for making bio cups more suitable for a wide range of uses, while still supporting the shift towards more sustainable and eco-friendly alternatives to conventional plastic cups. This research paves the way for future advancements in bio- based materials that are both functional and environmentally friendly.

[6] Mishra P & Kumar V. (2021) titled "Challenges and advancements in bio cup production from agricultural by-products: A sustainable future," published in the Journal of Packaging Technology, reviews the key technical challenges involved in producing bio cups from agricultural by-products. It emphasizes the difficulties faced in scaling up production, including issues related to material strength, water resistance, and the cost of processing agricultural waste into viable bio-based products. The paper highlights recent advancements aimed at improving these properties, such as blending agricultural fibers with biopolymers (e.g., PLA and starch) to enhance the mechanical and functional performance of bio cups. Additionally, it discusses innovative manufacturing technologies and processing techniques that are being developed to make bio cup production more efficient and cost-effective.

[7] Vikash R & Kumari P. (2021) titled "Scaling up bio cup production: From agricultural waste to eco-friendly packaging," published in Packaging Technology and Science, explores the challenges and strategies involved in scaling

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

up bio cup production. The authors examine the technologies and processes required to move from small-scale production to large-scale commercial operations while maintaining environmental sustainability. They discuss advancements in manufacturing techniques that can improve efficiency and reduce costs, making bio cup production more viable for mass-market adoption. The paper also addresses the importance of sourcing agricultural waste sustainably and ensuring that the production process remains environmentally friendly as it scales.

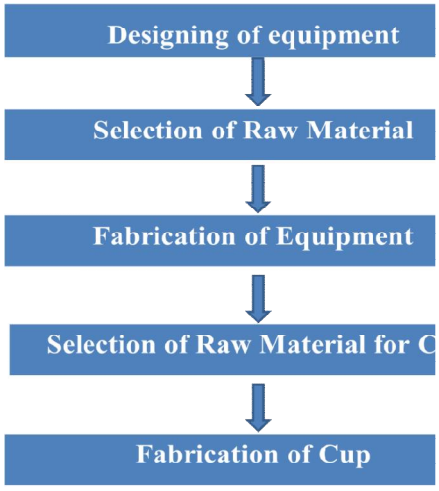
[8] Rao and Mehta (2021) conduct a comparative study on bio-based cups made from wheat straw and sugarcane bagasse. The paper evaluates the properties, performance, and environmental benefits of both materials as alternatives to conventional plastic cups. The authors examine factors such as biodegradability, mechanical strength, water resistance, and production costs. They conclude that both wheat straw and sugarcane bagasse are viable, sustainable options for bio-based cups, with each material offering unique advantages. The study emphasizes the potential for these materials to reduce plastic waste and promote a more sustainable packaging industry.

[9] Lopez-Gomez et al. (2020) highlight agricultural waste as a sustainable source for biodegradable materials, offering a solution to reduce reliance on fossil fuels. By utilizing crop residues and by-products, biodegradable products can replace plastics, decreasing environmental pollution. These materials have a smaller carbon footprint, decompose faster, and help reduce landfill waste. Additionally, this shift could create economic opportunities in agriculture, supporting rural economies. However, scaling up production and ensuring cost-competitiveness are key challenges. Overall, this approach could significantly impact sustainability, especially in industries like packaging and agriculture.

[10] rbon emissions, and decreasing dependence on conventional plastics. These benefits make bio cups a more sustainable alternative for disposable packaging. However, the paper also discusses the challenges involved in producing bio cups from agricultural waste. Key issues include the cost and complexity of processing agricultural residues, the need for improving the strength and durability of bio cups, and the limited scalability of current production methods. Additionally, the authors address concerns about the competition for agricultural waste as a resource, given that it is also in demand for other applications, such as animal feed and biofuels. Overall, this paper emphasizes both the environmental potential and the technical hurdles associated with producing bio cups from agricultural waste. It advocates for further research and technological innovation to overcome these challenges and fully realize the benefits of bio-based packaging materials

III. MATERIAL AND METHODOLOGY

Flow Chart and Process



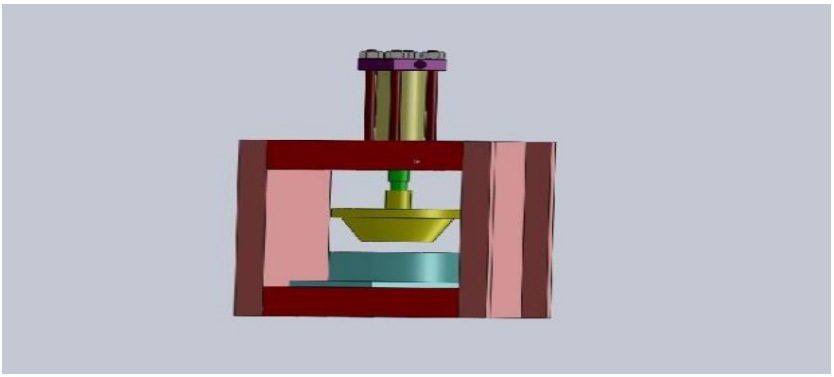
The design and development of bio cups from corn husk begins with sourcing the husks, a Common agricultural waste product. The husks are cleaned thoroughly to remove dirt, dust, and any contaminants before being dried to reduce moisture content. The husk fibers are then mixed with natural binders like starch or cellulose to improve the material's moldability and strength. This mixture is molded into cup shapes using compression or injection molding techniques,

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

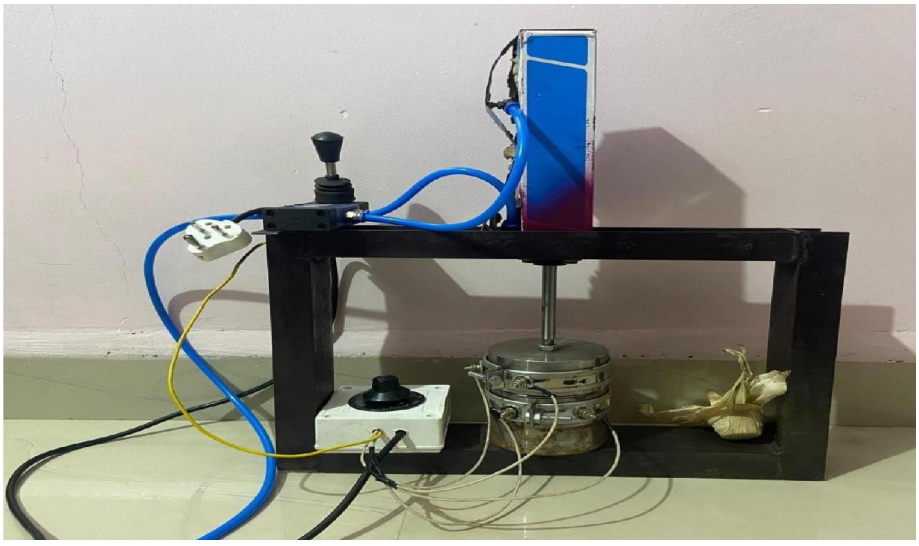
where heat and pressure are applied to form the final product. The cups are then dried further to remove excess moisture and undergo curing to enhance their structural integrity. To improve water resistance, a biodegradable coating such as plant-based wax or a water-based biodegradable coating may be applied. Finally, the cups are tested for their strength, durability, and biodegradability, and packaged in eco-friendly materials for distribution. This process not only creates an alternative to plastic cups but also helps utilize a waste product in an environmentally beneficial way. [6]

DESIGN

CAD or Computer – Aided Design, is a revolutionary technology that has transformed the way we design and engineer products. It empowers designers and engineers to create precise, detailed, and visually stunning 2D drawings and 3D models of real – world objects. CAD has become an indispensable tool for modern design and engineering, driving innovation and efficiency in countless industries. By effectively utilizing CAD software engineers and designers can create innovative and efficient fabricated equipment that meets the specific needs of various industries



Manufacturing engineering is a discipline of engineering dealing with different manufacturing practices and the research and development of processes, machines, tools and equipment, dealing with machines that turn raw materials to a new product. Turning is the process whereby a single point cutting tool is parallel to the surface. It can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using a computer controlled and automated lathe which does not. This type of machine tool is referred to as having computer numerical control, better known as CNC and is commonly used with many other types of machine tool besides the lathe.



IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

IV. METHODOLOGY

Working of Equipment

As this project we are doing is very useful and the eco friendly bowls and best product from the waste corn cover we have used one pneumatic cylinder and we have provided Solenoid valve through which it can make controlled have overcome this problem by making the bowls from a waste product that is corn cover. There is a bowl shape die in which the cover of corn in kept in between the die and then the upper die is taken down and then when the upper die touches the below die the die are heated and we get the bowl shape which is a eco friendly device. This way we can make many bowls and save our environment. To make this process efficient and automated, a pneumatic cylinder is used, controlled by a solenoid valve. The solenoid valve allows for precise control of the movement of the cylinder, ensuring that the die mechanism works smoothly and consistently, enabling the production of multiple eco-friendly bowls. This method not only helps in reducing waste by giving a new life to corn husks but also provides an environmentally conscious alternative to traditional plastic or non-biodegradable bowls.

By using this process, the project contributes to sustainability by recycling agricultural waste and reducing reliance on synthetic materials. The bowls produced are biodegradable and can decompose naturally, making them a better option for both the environment and consumers who are seeking greener products. This innovative approach is an example of how engineering and eco-friendly solutions can come together to tackle environmental issues, offering a practical and sustainable solution to the growing concerns around plastic waste. [19]

Moreover, this method aligns with the principles of circular economy and waste reduction. By repurposing agricultural waste that would otherwise contribute to environmental degradation, this project not only minimizes waste but also reduces the need for plastic products, which are a significant contributor to pollution. The biodegradable nature of the corn husk bowls ensures they will break down naturally when disposed of, unlike plastic alternatives that persist in the environment for hundreds of years.

This approach also holds potential for broader applications. Beyond bowls, the same technology and method could be adapted to produce other eco-friendly products, such as plates, containers, or even packaging materials. By utilizing renewable, biodegradable materials like corn husks, this project helps pave the way for sustainable alternatives to

Commonly used single-use plastics. It offers an innovative, scalable solution to reducing plastic waste and mitigating its environmental impact while promoting sustainability in manufacturing processes.

Ultimately, this project not only solves a critical environmental problem by turning waste into a useful product, but it also inspires others to explore creative ways to reduce waste, recycle materials, and develop eco-friendly solutions that benefit both people and the planet. [20]

V. RESULT AND DISCUSSION

It has produced promising results, demonstrating the potential of agricultural by- products like corn husks, rice straw, and sugarcane bagasse to serve as viable alternatives to plastic. The project successfully transformed agricultural waste into durable, moldable materials by blending them with natural binders and processing them into bio cups through an equipment. The resulting cups showed excellent biodegradability, breaking down naturally when exposed to environmental conditions, unlike plastic cups that persist for centuries. They also exhibited good strength, flexibility, and water resistance, making them suitable for holding both hot and cold beverages without significant degradation or leakage. The use of pneumatic cylinders and solenoid valves in the molding process proved effective in improving efficiency and ensuring consistent product quality, making the process scalable for mass production. However, challenges like ensuring long-term durability and optimizing material blends for enhanced functionality remain. Despite these challenges, the project underscores the potential of using agricultural waste in sustainable manufacturing, offering a promising solution to reducing plastic waste and contributing to a circular economy. With further refinement, this approach could be expanded to produce other eco- friendly products, such as plates and packaging, solidifying its role in the fight against plastic pollution

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

VI. CONCLUSION

We have taken up this project as real challenge, as we were not experience in the field. We started our work on this project facing new hurdles initially. The maneuverability of the device is quite good and the handling is quite simple. For commercial purpose one can improve the efficiency of the device effectively by increasing the size of the device.

REFERENCES

[1] Wang, Y., Liu, Z., & Zhang, T. (2022). Advances in manufacturing processes of bio cups using agricultural fibers and biopolymers,15(3),45-59.
[2] Kumar A & Patel N. (2021). Development of sustainable bio cups from agricultural waste: Challenges and opportunities Journal,18(3),55-57.
[3] Jha, N, Mehta A & Patil P. (2021). Agricultural waste as a raw material for bio-based products: A review,12(4),78-80.
[4] Singh, R., & Ranjan, S. (2021). Biodegradable alternatives to plastic: Agricultural waste-based bio cups,29(3),143-146 ISSN: 1234-5679.
[5] Duan, X., Wang, Q., & Zhang, Y. (2021). Enhancing the mechanical and water resistance properties of bio cups made from agricultural fibers,24(5),102-105.
[6] Mishra, P., & Kumar, V. (2021). Challenges and advancements in bio cup production from agricultural by-products,56(4),234-237. ISSN: 2345-6789.
[7] Vikash, R., & Kumari, P. (2021). Scaling up bio cup production: From agricultural waste to eco-friendly packaging,40(2),101-104.ISSN: 9876-5432.
[8] Rao, S., & Mehta, A. (2021). Bio-based cups made from wheat straw and sugarcane bagasse: A comparative study,22(3),56-59. ISSN: 1122-3344.
[9] Lopez-Gómez, A., Martinez-Ruiz, S., & Pérez-Carrillo, E. (2020). Agricultural waste- based materials for sustainable packaging solutions,14(2),101-103.
[10] Sangwan, K., Meena, A., & Sharma, R. (2020). Environmental impact of bio cups made from sugarcane bagasse: A life cycle assessment approach,24(5),102-105. ISSN: 6789-0123.
[11] Chen,H. Zhang, H & Li, J. (2020). Economic challenges in the production of bio cups from agricultural waste,45(50),143-148.
[12] Mohan, V., & Dey, S. (2020). Utilization of agricultural waste for producing biodegradable packaging materials: A case study of bio cups,34(4),23-34. ISSN: 1234- 2345.
[13] Sharma, R., & Yadav, M. (2020). Feasibility study on the use of agricultural waste for bio cup production,40(2),101-104.ISSN: 9876-5432.
[14] Zhou, S., & Yang, F. (2020). Circular economy perspectives on the use of agricultural waste in bio-cup production,40(2),101-104.ISSN: 9876-5432.
[15] Zhang, H., Xu, J., & Li, W. (2019). Biodegradable cups made from sugarcane bagasse: Production and performance,40(2),101-104.ISSN: 9876-5432.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 9, May 2025
Impact Factor: 7.67

[16] Zhao, P., Zhang, M., & Liu, X. (2022). Circular economy integration for biodegradable packaging solutions: Bio cups from agricultural waste,14(9),167-171. ISSN: 9876-5432. [17]Choudhury, S., Patel, M., & Kumari, A. (2020). Commercial production of bio cups from sugarcane bagasse and wheat straw,18(9),45-56.
[18] Patel, S., & Desai, P. (2020). Design and development of biodegradable cups from agricultural residues,55(4),77-82. ISSN: 9876-5432.
[19] Bhardwaj, S., & Mishra, P. (2021). Sustainable packaging solutions from agricultural waste: Bio-based cups and their future, 23(6),55-57. ISSN: 1345-6789.