

RESEARCH ARTICLE

# Environmental Impact Awareness in Sustainable Product Design and Production of Adinkra Symbol Jewellery

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## Abstract

In today's world, the pressing need for sustainable practices has become increasingly evident. The importance of sustainable product design in reducing environmental impacts cannot be overstated. There is the problem of depletion of our resources, climate change, pollution and improper waste management which all hinder sustainable living. The purpose of this study is to explore solid waste and convert it into sustainable Jewellery with the incorporation of the *Gye Nyame* Adinkra symbol into product design development to minimize environmental damage.

## repurposing, solid waste sustainable jewellery

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The study employed a creative art research approach under qualitative research adopting various tools and materials for the fabrication of the jewellery. The outcome of the study showed that repurposing solid waste that would otherwise end up in landfills into sustainable jewellery contributes to a greener future. The study recommends the government create economic opportunities for communities in product design and also incorporate sustainable development into design education.

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## Introduction

The goal of sustainable product design is to minimize the negative environmental impacts associated with production and consumption. This includes considering the entire life cycle of a product, from material acquisition to disposal, to reduce resource consumption, waste production and pollution (Tischner & Charte, 2017). According to Zhang et al. (2020), one key factor in environmental impact awareness in sustainable product design is the use of environmentally friendly materials. Also, Watkins et al (2021) express that another important aspect is the disposal of the product at the end of its useful life. Sustainable product design encourages the use of easily recyclables which reduces the amount of waste that ends up in landfills. Designers can also explore innovative approaches, such as designing degradable products where materials are recycled and recycled into new products (Haid & Albrecht, 2021). Ahmad et al. (2018) arguably add that sustainable product design requires planning for durability and longevity. By creating products that are built to last, designers can reduce the need for frequent replacements, which reduces resource consumption and waste. This can be achieved through high-quality materials, durable construction techniques and repair-friendly design. Sustainable product design encourages responsible and ethical practices throughout the supply chain. This includes ensuring fair labour practices, promoting safe working conditions and supporting local communities (Vinodh & Rathod, 2010). By considering the social and environmental impact of the entire production process, designers can create products that not only reduce harm but also contribute to society. Cappellieri et al. (2020) opine that in recent years, a growing need for sustainable practices has been observed in various

industries such as fashion and jewellery. Traditional production processes often cause significant environmental degradation, from excessive resource consumption to pollution and waste generation. Sustainable product design aims to mitigate these negative effects by adopting innovative approaches that prioritize environmental responsibility (Lerma et al. 2017).

Originating from the Akan of Ghana, Adinkra symbols have deep cultural meaning and convey wisdom, proverbs and values (Rattray, 1927). Adom (2016) indicates that these symbols are traditionally used in textiles and other art forms. By combining Adinkra symbols with sustainable jewellery, we not only give these jewellery cultural significance but also create an effective platform to spread environmental awareness. Each symbol has its unique message, such as unity, sustainability or respect for nature. By using these symbols, people not only express their style but also show their commitment to sustainable development and environmental awareness. The choice to use sustainable materials in the production of jewellery complies with the principles of reduction, reusing and recycling. For example, using solid waste as a jewellery material not only prevents them from ending up in landfills but also reduces the need to recycle new raw materials. This practice promotes a circular economy where materials are used and recycled in a closed loop, minimizing waste and conserving resources and nature. Previous studies delved into by researchers related to the study saw Tegegne (2018) look into sustainable jewellery. The study talked about an alternative approach to sustainability in jewellery. This research was aimed at developing and promoting sustainable jewellery collections in a way that executes socially and environmentally responsible practices. This practice included encouraging the use of recycled resources and handcrafting, which was believed to reduce the impact of the jewellery industry on environmental sustainability drawing inspiration from African jewellery. Also, Romãozinho (2021) researched sustainability in the jewellery design process: reusing and reinventing. The study highlighted the methodology underlying the fabrication of a contemporary jewellery collection inserted in a project with its main principles: versatility and reuse. The project adopted traditional techniques such as cutting forming and joining in a production line close to product design. Contextually these studies were limited to sustainable practices, the history of African jewellery and product design.

The study seeks to use eco-friendly materials in creating Adinkra symbol jewellery to reduce harm to the environment. Additionally, the research would aim to analyze the Adinkra symbol for jewellery and also pinpoint areas where sustainable methods can be integrated. It would also involve showing the production stages of jewellery-making. The ultimate goal would be to establish guidelines for designers to infuse environmental awareness and sustainability into the

crafting of Adinkra symbol jewellery. Lastly, the research would seek to propose effective strategies for raising awareness about the environmental impact of jewellery production and advocating for sustainable practices within the industry.

## **Literature Review**

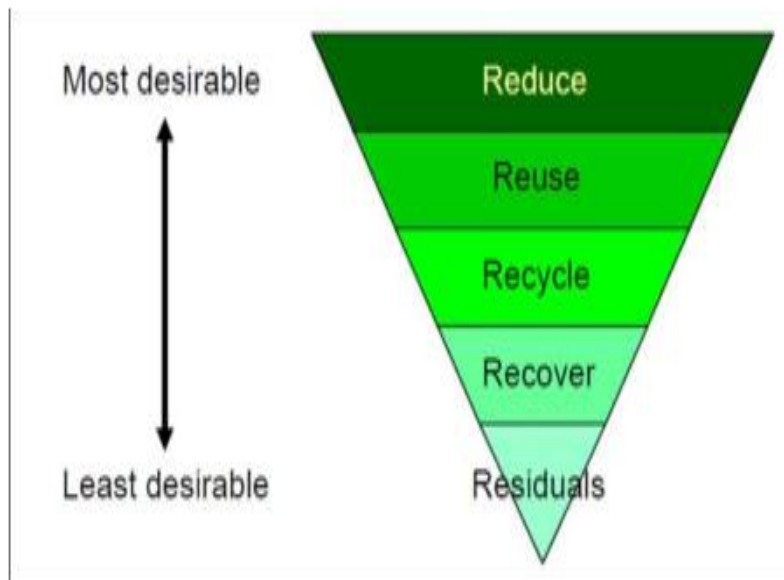
### **Theoretical Framework**

The study adopted Wong & Lai's (2011) theory of production. The theory of production plays a crucial role in understanding how the creation of Adinkra symbol jewellery can be aligned with sustainable practices to minimize environmental impact. The theory of production examines the process of transforming inputs, such as materials and labour, into outputs. This shows how the solid waste being the material collected from sites in Accra is being fabricated showing the various production processes from the fabrication stage to the finishing stage into jewellery incorporating the Adinkra symbol. By applying sustainable production principles, designers can focus on using eco-friendly materials, reducing waste, and incorporating energy-efficient manufacturing processes to lessen the environmental footprint of jewellery production. Integrating concepts like eco-design, life cycle assessment, and green manufacturing techniques can help ensure that the production of Adinkra symbol jewellery is environmentally responsible and contributes positively to sustainable product design.

### **Adopted Model**

The study adopted Gunda & Nleya's (2016) model of solid waste recycling depicting the principles of recovering, recycling, reusing and reducing solid waste into useful and sustainable products. The study elaborates on the principle of recycling focusing on recovering valuable materials from waste streams and landfills to ensure they are not lost or wasted. This can include techniques such as melting down scrap metal or removing gems from old jewellery. By recycling these materials, we can minimize waste and save resources. In the context of sustainable jewellery relating to the theme of the study which includes recovering scrap metal to create new jewellery components. Instead of throwing away or melting down scraps, it can be recycled and given new life. This can mean repurposing solid waste, incorporating them into new designs or even using them as decorative elements for other jewellery. Recycling of materials reduces waste and extends the life of existing resources.

The principle of reduction focuses primarily on minimizing waste and resource use. This can include designing jewellery with efficiency in mind, using as few materials as possible, and implementing sustainable practices throughout the manufacturing process. By reducing the consumption of waste and resources, we can create more economical and environmentally friendly jewellery. Researchers have adopted the solid waste recycling model in their studies; Shinkuma & Managi (2011) discuss how main problems for waste management can be addressed through appropriate policies that should be implemented by the government with recycling taken into consideration. The study used the solid waste recycling model to expatiate how solid waste management can be addressed. Also, Cohen et al (2021) researched trust between municipalities and residents: a game-theory model for municipal solid-waste recycling efficiency. The study used game-theory tools to identify difficulties that a municipality and its residents face in building and operating infrastructure for recycling by adopting the solid waste recycling model for emphasis. The model illustrated in Figure 1 shows an order in which solid waste is been converted to product to improve environmental conservation. The first step depicts how residuals of solid waste and the next step show how these solid wastes are being recovered from landfills. These solid wastes are washed, cleaned and converted from solid waste into useful products. The product is being repurposed into a piece of jewellery following the hierarchy illustrated in the diagram. Lastly, the model shows the jewellery fabricated to promote environmental conservation and reduce solid waste at landfills. Figure 1 shows the theoretical model of solid waste recycling asserted by Gunda & Nleya (2016).



**Figure 1:** Theoretical model of solid waste recycling.

**Source:** Gunda & Nleya (2016)

## **Solid Waste Recycling**

According to Exposito & Velasco (2018), solid waste recycling is an important part of waste management, which includes the collection, processing and recycling of various waste materials. Recycling helps reduce the amount of waste that ends up in landfills, conserve natural resources and minimize environmental pollution. Siddiqi et al. (202) arguably support the view that one of the main goals of solid waste recycling is to divert waste materials away from landfills and into recycling facilities. These facilities use different methods to sort, clean and process recyclable materials such as paper, plastic, glass and metal. Once these materials are processed, they can be turned into new a product, which reduces the need for raw materials and minimizes the environmental impact of their extraction and production. Recycling also plays an important role in saving natural resources. By recycling materials, individuals can reduce the demand for new natural resources such as wood, oil and minerals. For example, recycling paper helps protect forests and reduces the energy needed to make new paper from trees. Also, recycling metals such as aluminium and steel reduces the need for mining and quarrying, which can have a detrimental effect on ecosystems (Farzadkia et al., 2021).

Bui et al (2022) emphasize that in addition to saving resources, recycling helps reduce energy consumption and greenhouse gas emissions. Making new products from recycled materials often requires less energy than using primary natural resources. Recycling aluminium cans saves up to 95% of the energy needed to produce aluminium from raw materials asserted by Cano et al (2022). Also, Ayelewu et al. (2022) opine that recycling reduces energy consumption and helps curb climate change and promotes a more sustainable future. In addition, recycling solid waste can have a positive economic impact. The recycling industry creates jobs in various sectors, including collection, sorting, processing and manufacturing. These industries contribute to the local economy, foster innovation and promote sustainable business practices (Harijani & Mansour, 2022). Recycling also helps reduce the waste management costs of municipalities and companies by diverting expensive materials to landfills. To promote effective recycling of solid waste, it is important to raise awareness among individuals and communities about the importance of recycling and to create a convenient recycling infrastructure (Zhang et al., 2020). Also, Cohen et al. (2021) add that education and information programs can help people understand the benefits of recycling and encourage them to actively participate. Governments and organizations can also implement policies and incentives to support recycling initiatives and promote the development of the recycling industry.

In summary, solid waste recycling is an important part of waste management that offers many benefits. It helps conserve natural resources, reduce energy consumption and greenhouse gas emissions, create jobs and minimize environmental pollution. By recycling waste materials, we can promote a more sustainable and greener future for future generations.

### **Sustainable Product Design**

Watkins et al. (2021) opine that sustainable product design is an approach that focuses on creating products that have as little negative impact on the environment as possible during their life cycle. This includes considering the entire life cycle of a product, from sourcing materials to manufacturing, use and disposal. In the case of sustainable product design, designers try to minimize consumption of resources, reduce waste production and choose ecological materials. They prefer renewable and recyclable materials and materials with a smaller carbon footprint (Rusch et al., 2023). Han et al. (2021) arguably add that sustainable product design involves designing products that are durable, repairable and easily disassembled for recycling or reuse. Using the principles of sustainable design, products can be made more energy efficient, which reduces their environmental impact during use. To cite an example asserted by Haid & Albrecht (2021), energy-efficient appliances use less electricity, which reduces greenhouse gas emissions and consumers' energy costs. In addition, sustainable product design takes into account the social and ethical aspects of production. This includes ensuring fair labour practices, safe working conditions and responsible sourcing of materials. This includes avoiding the use of hazardous substances and minimizing the use of chemicals harmful to human health or the environment.

Watz and Hallstedt (2022) ascertain that sustainable product design also encourages a move towards a circular economy, where products are designed to be reused, repaired or recycled instead of being thrown away after use. This reduces the demand for new resources and minimizes the generation of waste. In a nutshell, sustainable product design is necessary to create a more sustainable and environmentally conscious future. This requires a holistic approach that takes into account the social and economic aspects of product design in addition to environmental impacts. By incorporating sustainability into product design, we can promote a more sustainable world.

### **Adinkra Symbols for Jewellery**

Kissi (2019) indicate that the Adinkra symbols have a rich cultural meaning and are often used in jewellery design. These symbols originate from the Akan people of Ghana and represent various concepts, proverbs and values (Rattary, 1927). Incorporating Adinkra symbols into jewellery not

only adds aesthetic appeal but also has deeper meanings and is a way to connect with Akan heritage (Fening, 2016). Some Adinkra symbols are incorporated and commonly used in jewellery design. The *Gye Nyame* symbol is one of the most famous Adinkra symbols. It has a stylized image of the sun and represents God's omnipotence and sovereignty. It represents the belief that everything happens under the watchful eye of a higher power (Dzokoto et al., 2016).

Seeman (2010) shows that the *Sankofa* symbol represents a bird with its head turned back and its feet forward. It symbolizes the importance of learning from the past and using that knowledge to move forward. It encourages people to reflect on their roots, history and experiences, emphasizing the value of wisdom and knowledge. Also, the *Akoma* symbol asserted by Owusu (2019) depicts a heart-shaped and symbolizes love, patience and understanding. It symbolizes the importance of these qualities in human relations and interactions with others. *Akoma* symbolizes the interconnectedness of hearts and the importance of promoting love and compassion. This symbol has a stylized sun with a face. It represents God's omnipresence and the belief that God is always watching over us. It is a reminder of divine protection, guidance and the presence of a higher power in our lives. The symbol "Dwennimmen" represents a ram's horn and symbolizes humility, strength and wisdom. It encourages people to approach life with humility, recognize the power within them and embrace wisdom in decisions (Akyeampong, 2000). A literature review on solid waste, sustainable product design and jewellery Adinkra symbols is relevant to the study of environmental awareness of sustainable product design, as it helps to understand the potential environmental impacts of jewellery production and consumption. By looking at the recycling of solid wastes into jewellery, including the materials used, production processes and disposal, we can identify areas where sustainable practices can be implemented.

## **Materials and Methods**

### **Study Area**

Geographically, the study was centered in Accra illustrated in Figure 1. Accra is the capital town of the Greater Accra Region. The suburbs of Adenta, Amrahia, Malejor, Oyibi and Sasaabi located in Accra were the focus of the research which provided an interesting study area for solid waste collection in the context of jewellery production. Accra, being the capital city of Ghana, is known for its vibrant culture and rich heritage, including the production of traditional Adinkra symbol jewellery. In Adenta, studying solid waste collection in relation to jewellery can shed light on the environmental impact of jewellery production and consumption in the local community. This includes examining the waste generated during the manufacturing process, such as metal scraps

(bottle caps, remnants and packaging materials).



**Figure 2:** Map of suburbs of Accra

**Source:** <https://mapcarta.com/N2154259298>

### Study Design

Utilizing solid waste conversion in conjunction with the recycling procedure, this study applied creative art-based research to transform discarded solid waste into an artistic result. Brearley (2008) states that creative-based research is a unique research done with the goal of learning new things, sometimes using art and its results. The uniqueness and knowledge-adding assertions made in this study are substantiated by imaginative results of jewellery. The relevance and context of the claims are verbally explained using a descriptive analysis tool, and the whole comprehension is gained with specific reference to the result (Kemp et al., 2018). The full claim of the artwork was provided with a descriptive analysis and working procedures by this art-based research. It begins with a description of the tools and materials used in fabricating the jewellery.

### Sampling

The study further used purposive sampling to select participants who could provide rich and diverse perspectives on the topic. Leeming (2018) opines that purposive sampling involves deliberately selecting participants who meet specific criteria, aiming to include individuals with

certain characteristics relevant to the research. The study shows the distribution of accessible population for the study with the assertion of a sample size of 30% by Cohen and Manion (1985).

Population of the study	Accessible population	Sample size 30%
Adenta	30	10
Amrahia	15	5
Malejor	15	5
Sasaabi	15	5
Oyibi	9	3
Total:	84	28

**Table 1.0:** Distribution of accessible and sampled population for the study

**Source:** Fieldwork by researchers (2024)

### Data Collection Tools

An in-depth interview such as the unstructured interview was employed to interact with participants to explore the various landfills in the suburbs. These five towns are suburbs of Accra in the Greater Accra Region of Ghana. These towns were selected because preliminary research by the lead researcher revealed that they had landfills of solid waste. A well-designed observation checklist for observation was designed and validated via an expert review by two seasoned qualitative researchers. It was used for gathering data on the various solid waste in the suburbs related to the study.

### Ethical Consideration and Data Analysis Plan

All ethical aspects of the study, including informed consent, exposure to risk and anonymity, were carefully monitored. Subjects were fully aware of the study and the benefits of participation to give their informed consent. All respondents were informed about the study, that it was only a survey and that participation in it would not endanger them socially, emotionally or physically. Interviews were conducted face-to-face and recorded. Each observed class was audio recorded and regular field notes were taken for thematic analysis (Joffe, 2011).

## Tools and Materials

The study adopted the various tools, equipment and materials illustrated in Table 1 used in the fabrication of the jewellery. The various processes involved cutting, filing and giving a finish to the jewellery made from solid waste.

Tools and Materials	Uses
Jeweller's Files	A tool used to remove unwanted metal pieces
Jeweller's Saw	The saw is used for piercing metal
Sponge and foam	Materials are used for the cleaning and painting process.
Paint Brush	A tool used for painting.
Acrylic Paint	A material used in finishing jewellery.
Scratch brush	A tool used for scratching and cleaning the metal bottle cap.
Flexi Shaft	Equipment used for drilling holes, grinding and polishing.
Copper wire	A material used for the earwire, an attachment to the ear.
Graffiti Spray	A material used in finishing jewellery.

**Table 1:** Tools and materials for jewellery

(Source: Fieldwork, 2024)

## Results and Discussion

### Pre-fabrication Stage

A significant portion of the creative process of art was observed during the pre-fabrication phase of this creative art approach by developing jewellery incorporating the Adinkra symbol. The pre-fabrication stage started with the collection of various solid wastes and later cleaning them for the fabrication process.

### Collection of Solid Waste for Recycling

The collection process plays an important role in ensuring the continuous availability of solid waste and other solid waste for the jewellery. It included several steps to collect solid waste related to the

solid waste for recycling. The first step was to establish designated collection points in the community. Public spaces, community centres, schools and local businesses had to be placed strategically. The researchers provided clear labels and containers specifically for collecting solid waste. This made it easier for community members to remove solid waste and ensured that the collection process was organized and efficient because it was quite difficult to get solid waste to make jewellery.

### Sorting and Preparation

After the solid wastes are collected, they must be sorted to remove the solid waste illustrated in Figures 3 and 4 to be ready for the fabrication of jewellery. To do this, the researchers removed all non-metallic parts, such as plastic or rubber covers, and thoroughly cleaned the solid waste shown in Figures 5 and 6. The researchers sorted by colour and size of the bottle cap and added other solid waste for the fabrication process of the jewellery. Sufficient storage facilities were available to store the collected solid waste until the ones needed for the fabrication of jewellery were ready for processing. This ensured that the solid waste remained in good condition and was protected from damage and dirt.



**Figure 3:** Sorting of solid waste  
**Source:** Photographed by researchers (2024)



**Figure 4:** Sorting of other solid waste  
**Source:** Photographed by researchers (2024)



**Figure 5:** Cleaning of solid waste with scratch brush and sponge

**Source:** Photographed by researchers (2024)



**Figure 6:** Washing of solid waste

**Source:** Photographed by researchers (2024)

## **Fabrication Stage**

### **Priming and Painting of solid waste**

Since the solid waste illustrated in Figures 3 and 4 displayed a rusty surface, it was primed before the application of paint to the solid waste. Priming helped create an even surface and improved paint adhesion. Applying a thin coat of metallic primer and letting it dry completely before proceeding to the next step. The researchers used a small foam or sponge applicator to paint the solid waste after spraying with the graffiti spray shown in Figures 7 and 8. The chosen background colour for the jewellery was black. The researchers allowed each coat of paint to dry before applying additional coats as needed illustrated in Figures 9 and 10. More complex designs were going to be incorporated into the jewellery including the Adinkra symbol where a fine-tipped brushes or even stencils were needed.



**Figure 7:** Application of black paint with foam  
**Source:** Photographed by researchers (2024)



**Figure 8:** Application of blue paint with foam  
**Source:** Photographed by researchers (2024)



**Figure 9:** Dried blue caps for next coating  
**Source:** Photographed by researchers (2024)



**Figure 10:** Dried black caps for next coating  
**Source:** Photographed by researchers (2024)

### Fixing of Earwire

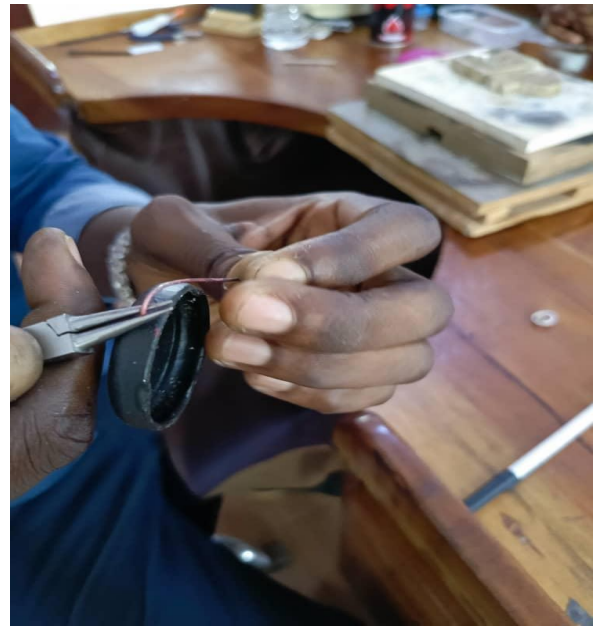
The researchers needed some basic tools and materials to attach the ear wire to your jewellery. The researchers needed earwires made from copper and jewellery pliers (such as round nose pliers

an and chain pliers). The process started by preparing the ear wires. The researchers drilled holes in the solid waste to place the earwires shown in Figure 11. The researchers took one ear wire and used the pliers to make a small loop at the end of the wire (Figure 12). This loop prevented the jewellery from slipping off the ear wire (Figure 13). After the researchers added the desired jewellery, the researchers grabbed the loop they created earlier with the chain pliers and closed the loop which gently bent the thread and made sure it was properly closed. This process was repeated for the second earring and the final solid waste with attached ear wires are illustrated in Figure 14.



**Figure 11:** Perforating of holes

**Source:** Photographed by researchers (2024)



**Figure 12:** Making of loop

**Source:** Photographed by researchers (2024)



**Figure 13:** Installed loop for jewellery

**Source:** Photographed by researchers (2024)



**Figure 14:** Installed earwire for jewellery

**Source:** Photographed by researchers (2024)

### **Incorporation of Adinkra Symbol with Acrylic Paint**

The researchers selected the Adinkra symbol to be added to the jewellery. The necessary materials, including white acrylic paint, a small brush and a palette or mixing surface were used by the researchers for the incorporation of the design. The researchers drew the Adinkra symbol on the jewellery with a pencil. This acted as a guide for painting and helped ensure accuracy. The researchers mixed the acrylic paint: by squeezing a small amount of white acrylic paint onto a palette or mixing surface. The researchers dipped the brush in acrylic paint and carefully filled in the Adinkra symbol drawn on the jewellery (Figure 15). The desired effect of the Adinkra symbol is illustrated in Figure 16.



**Figure 15:** Painting Adinkra symbol on jewellery black and white

**Source:** Photographed by researchers (2024)



**Figure 16:** Painted Adinkra symbol in black and white

**Source:** Photographed by researchers (2024)



**Figure 17:** Painted Adinkra symbol in blue and yellow

**Source:** Photographed by researchers (2024)

### Finishing of Jewellery

Once the paint was dried, the researchers considered adding a protective topcoat to seal the paint and prevent it from cracking or fading over time. As a final touch, transparent acrylic sealants or varnishes for metal surfaces were used. The researchers allowed the jewellery to dry completely and cured according to the paint manufacturer's instructions. It ensured good adhesion of the

paint and provided a durable surface (Figures 18 and 19).



**Figure 18:** Finished jewellery

**Source:** Photographed by researchers (2024)



**Figure 19:** Finished coated jewellery

**Source:** Photographed by researchers (2024)

### **Emphasis on Environmental Impact Awareness in Product Design**

One key aspect of emphasizing environmental awareness in product design considers the entire life cycle of a product, from the extraction of its raw materials to its disposal. This approach, called life-cycle thinking according to Cohen (2021) from the literature, helps designers identify opportunities to reduce environmental damage at each stage. For example, the chosen materials that are renewable, recyclable or biodegradable. Design products that are durable and repairable to extend their lifespan. Designers increasingly combining circular economy principles with their product design strategies. This approach aims to minimize waste and maximize resource efficiency by designing products that can be easily disassembled, repaired or recycled ascertained by Watz & Hallstedt (2022) in the literature. Following the principles of the circular economy by Watz & Hallstedt's study, designers contribute to reducing the amount of waste generated and encourage the reuse of materials, which reduces the overall environmental impact.

### **Justification of Design (Adinkra Symbol)**

When it comes to jewellery, a prominent Adinkra symbol that has meaning is the *Gye Nyame* symbol was incorporated in the fabrication of the jewellery. The *Gye Nyame* symbol consists of a stylized representation of a human-like figure with its head surrounded by a circle. This symbol

represents God's omnipotence and sovereignty. *Gye Nyame* means "besides God" in the Akan language spoken by the Akan people of Ghana (Kissi et al., 2019). In this context, the *Gye Nyame* symbol is often affixed to various items such as necklaces, bracelets, and rings. It is a powerful reminder of the divine presence and the belief that everything happens under God's watchful eye. People who wear jewellery with the *Gye Nyame* symbol can personally express their faith, spirituality or connection to Ghanaian culture. The design of the *Gye Nyame* symbol itself is visually interesting. A human-like figure with an upturned head means looking to a higher power, guidance and protection. The circle surrounding the figure represents the eternal nature of God and the interconnectedness of all things (Fening, 2016). Wearing *Gye Nyame* symbol incorporated into the jewellery can be a way to embrace and celebrate Ghanaian culture, spirituality and belief in a higher power. It serves as a meaningful and visually striking accessory that carries a deep symbolic message.

### Findings from the Study

One of the key observations is the growing understanding of the importance of considering the entire product life cycle. Designers now are more aware of the environmental impacts associated with each step, from raw material extraction to disposal. By following a life cycle approach, designers can identify opportunities to reduce environmental damage. This includes choosing renewable, recyclable or biodegradable materials and designing durable and repairable products to extend their life. The principles of a circular economy have also emerged as a key finding in sustainable product design. Designers embrace the concept of a circular economy, which aims to minimize waste and maximize resource efficiency. This requires designing products that can be easily disassembled, repaired or reused. Following the principles of the circular economy, designers contribute to reducing the amount of waste generated and promote the reuse of materials, thus reducing the general environmental impact. Collaboration and innovation are also the main results of environmental awareness in product design. Designers actively seek partnerships with suppliers, producers and consumers to jointly solve the challenges of sustainable development. Through collaboration, they can share knowledge and resources to develop more sustainable products. In addition, designers are constantly researching innovative materials and manufacturing techniques that have a lower environmental impact. Government regulations and industry standards play an important role in shaping the emphasis on environmental awareness in product design. Many countries have introduced stricter environmental regulations and certifications that encourage sustainable practices. These regulations encourage designers to use environmentally friendly materials, production processes and disposal methods.

## Conclusion

Sustainable product design aims to minimize the negative environmental impacts associated with production and consumption. Incorporation of Adinkra symbol which serves as a meaningful and visually striking accessory that carries a deep symbolic message to the public. The study was limited to Adenta where geographically other communities could have been explored. The scavenger hunt for solid waste wasn't easy which could have been a cause of producing jewellery where other design products could have been explored and fabricated. The findings from environmental impact awareness in sustainable product design highlight the significant progress being made in creating more environmentally responsible products. Designers are increasingly considering the entire lifecycle of products, from raw material extraction to disposal, and incorporating eco-friendly materials and manufacturing processes. The focus on embracing circular economy principles, and fostering collaboration and innovation further demonstrates the commitment to sustainability. With the support of government regulations and industry standards, the design industry is moving towards a more environmentally conscious approach. The study recommends collaboration and innovation which are also key factors in realizing the environmental impact of product design. Designers should actively seek partnerships with suppliers, producers and consumers to jointly solve the challenges of sustainable development which is a strength in product design. They should research innovative materials and manufacturing techniques that have a lower environmental impact. In addition, designers should engage with consumers through educational campaigns and transparent communications to promote awareness and responsible consumption. Lastly, government regulations and industry standards play an important role in shaping the emphasis on environmental awareness in product design. The study highlights future research on emphasizing the benefits of sustainable product design in reducing waste and environmental conservation.

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## Authorship and Level of Contribution

All authors contributed equally.

## References

- Adom, D. (2016). Adinkra: An epitome of Asante philosophy and history. *Research on Humanities and Social Sciences*, 6(14), 42-53.
- Ahmad, S., Wong, K. Y., Tseng, M. L., & Wong, W. P. (2018). Sustainable product design and development: A review of tools, applications and research prospects. *Resources, Conservation and Recycling*, 132, 49-61.
- Brearley, L. (2008). Introduction to creative approaches to research. *Creative Approaches to Research*, 1(1), 3-12.
- Bui, T. D., Tseng, J. W., Tseng, M. L., & Lim, M. K. (2022). Opportunities and challenges for solid waste reuse and recycling in emerging economies: A hybrid analysis. *Resources, Conservation and Recycling*, 177, 105968.
- Cano, N. S. D. S. L., Iacovidou, E., & Rutkowski, E. W. (2022). Typology of municipal solid waste recycling value chains: A global perspective. *Journal of Cleaner Production*, 336, 130386.
- Cappellieri, A., Tenuta, L., & Testa, S. (2020). Jewellery between product and experience: luxury in the twenty-first century. *Sustainable luxury and craftsmanship*, 1-23.
- Cohen, C., Halfon, E., & Schwartz, M. (2021). Trust between municipality and residents: A game-theory model for municipal solid-waste recycling efficiency. *Waste Management*, 127, 30-36.
- Cohen, L. Manion L (1985). *Research methods in education*. Elsevier Publishers.
- Dzokoto, V., Hill, A., Twum-Asante, M., & Hayfron, A. E. (2018). Saying more than goodbye: emotion messages in Adinkra symbols. *Journal of visual literacy*, 37(4), 255-275.
- Exposito, A., & Velasco, F. (2018). Municipal solid-waste recycling market and the European 2020 Horizon Strategy: A regional efficiency analysis in Spain. *Journal of Cleaner Production*, 172, 938-948.
- Farzadkia, M., Mahvi, A. H., Norouziyan Baghani, A., Sorooshian, A., Delikhoon, M., Sheikhi, R., & Ashournejad, Q. (2021). Municipal solid waste recycling: Impacts on energy savings and air pollution. *Journal of the Air & Waste Management Association*, 71(6), 737-753.
- Fening, P. A. (2015). Design Trends in Gold Jewellery Making in Ghana and Global Cultural Influence. *Journal of Arts and Humanities*, 4(4), 57-62.
- Gunda, L., & Nleya, M. B. (2016). *Integrated Municipal Solid Waste Management System*.
- Haid, M., & Albrecht, J. N. (2021). Sustainable tourism product development: An application of product design concepts. *Sustainability*, 13(14), 7957.

- Haid, M., & Albrecht, J. N. (2021). Sustainable tourism product development: An application of product design concepts. *Sustainability*, 13(14), 7957.
- Harijani, A. M., & Mansour, S. (2022). Municipal solid waste recycling network with sustainability and supply uncertainty considerations. *Sustainable Cities and Society*, 81, 103857.
- Kemp, S. E., Ng, M., Hollowood, T., & Hort, J. (2018). Introduction to descriptive analysis. *Descriptive analysis in sensory evaluation*, 1-39.
- Joffe, H. (2011). Thematic analysis. *Qualitative research methods in mental health and psychotherapy: A guide for students and practitioners*, 209-223.
- Kissi, S. B., Fening, P. A., & Asante, E. A. (2019). The philosophy of Adinkra symbols in Asante textiles, jewellery and other art forms. *Journal of Asian Scientific Research*, 9(4), 29.
- Leeming, D. (2018). The use of theory in qualitative research. *Journal of Human Lactation*, 34(4), 668-673.
- Lerma, B., Dal Palù, D., Actis Grande, M., & De Giorgi, C. (2017). Could Black Be the New Gold? Design-Driven Challenges in New Sustainable Luxury Materials for Jewellery. *Sustainability*, 10(1), 2.
- Owusu, P. (2019). Adinkra symbols as "multivocal" pedagogical/socialization tool. *Contemporary Journal of African Studies*, 6(1), 46-58.
- Rattray, R (1927) Religion and Art in Ashanti, London. Oxford University Press
- Romãozinho, M. (2021). Sustainability in Jewellery Design Process: Reusing and Reinventing. In *Advances in Design, Music and Arts: 7th Meeting of Research in Music, Arts and Design, EIMAD 2020, May 14–15, 2020* (pp. 403-414). Springer International Publishing.
- Rusch, M., Schöggel, J. P., & Baumgartner, R. J. (2023). Application of digital technologies for sustainable product management in a circular economy: A review. *Business Strategy and the Environment*, 32(3), 1159-1174.
- Seeman, E. R. (2010). Reassessing the "Sankofa symbol" in New York's African burial ground. *William & Mary Quarterly*, 67(1), 101-122.
- Shinkuma, T., & Managi, S. (2011). *Waste and recycling: theory and empirics*. Routledge.
- Siddiqi, M. M., Naseer, M. N., Abdul Wahab, Y., Hamizi, N. A., Badruddin, I. A., Hasan, M. A., ... & Kamangar, S. (2020). Exploring e-waste resources recovery in household solid waste recycling. *Processes*, 8(9), 1047.
- Tegegne, S. (2018). Sustainable jewellery. An alternative approach to sustainability in jewellery.
- Tischner, U., & Charter, M. (2017). Sustainable product design. In *Sustainable Solutions* (pp. 118-138). Routledge.
- Vinodh, S., & Rathod, G. (2010). Integration of ECQFD and LCA for sustainable product design. *Journal of Cleaner Production*, 18(8), 833-842.
- Watkins, M., Casamayor, J. L., Ramirez, M., Moreno, M., Faludi, J., & Pigosso, D. C. (2021).

Sustainable product design education: current practice. *She Ji: The Journal of Design, Economics, and Innovation*, 7(4), 611-637

Watkins, M., Casamayor, J. L., Ramirez, M., Moreno, M., Faludi, J., & Pigosso, D. C. (2021). Sustainable product design education: current practice. *She Ji: The Journal of Design, Economics, and Innovation*, 7(4), 611-637.

Watz, M., & Hallstedt, S. I. (2022). Towards sustainable product development—Insights from testing and evaluating a profile model for management of sustainability integration into design requirements. *Journal of Cleaner Production*, 346, 131000.

Wong, B. K., & Lai, V. S. (2011). A survey of the application of fuzzy set theory in production and operations management: 1998–2009. *International Journal of Production Economics*, 129(1), 157-168.

Zhang, D., Hao, M., Chen, S., & Morse, S. (2020). Solid waste characterization and recycling potential for a university campus in China. *Sustainability*, 12(8), 3086.

Zhang, X., Zhang, L., Fung, K. Y., Bakshi, B. R., & Ng, K. M. (2020). Sustainable product design: A life-cycle approach. *Chemical Engineering Science*, 217, 115508.

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