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Sustainable Fabric Manufacturing: The Crochet Experience

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Abstract: When it comes to the sustainability of fabrics, the materials used in textile production are frequently given more consideration than the manufacturing procedures. But a fabric's sustainability is also determined by its production techniques. One of the sectors of the global economy that has been shown to have the greatest environmental damage is the textile manufacturing sector. As a result, fabrics produced using techniques that leaves little or no negative impacts to the environment are said to be sustainable or eco-friendly. The study's aim is to promote environmental friendly method of fabric production through the crochet technique and to encourage its exploration in Nigeria. The aim was accomplished by focusing on crochet technique as a sustainable fabric manufacturing technique. The study highlighted ways crochet techniques agrees with sustainability as against the conventional methods of manufacturing fabric. Samples of successful sustainable fabric and other materials produced using the crochet technique were showcased. The economic feasibility and market potentials of sustainable crocheted fabrics were also examined. The study adopted mixture of exploratory and descriptive research methods. In conclusion the study advocated for the acquiring of crochet skill by local textile manufacturers as a way to minimize the negative impact of the production processes of conventional fabric on the environment and also a means of creating jobs for the unemployed youths in Nigeria.

Keywords: Sustainable fabric, Manufacturing, Crotchet, Technique, Environment

Introduction

An overview of sustainable fabric

All that has to be said about sustainable fabric is that it is something that can be preserved forever. In an attempt to counteract the damaging effects of conventional fabric manufacturing procedures on the environment, the textile manufacturing sectors are shifting their focus more and more toward the creation of sustainable fabrics. In general, textile materials produced from renewable or environmentally favorable sources are referred to as sustainably sourced fabrics. The sustainability of a fabric is, however, also influenced by its manufacturing techniques. Sustainable or environmentally friendly fabrics are also those made with processes that have minimal to no negative effects on the environment.

There are several ways to look at how sustainability is applied to the manufacturing or consumption of fabrics, including how the production of textiles or fashion items affects the environment or human population. These effects are seen in three main domains: environmental sustainability, which is focused on conserving resources and materials to lessen carbon emissions and protect the environment. Social sustainability, or the usage of fabrics produced without the use of exploitative labor methods, comes next. The last type of

sustainability is economic, which focuses on methods that will result in the creation of goods that the residents of the area can afford. In a nutshell, sustainable fabric production is fabric design and manufacturing done in a way that is more environmentally friendly. Stated differently, the goal of this study is to minimize or eliminate the negative effects that our methods and procedures for producing fabrics have on people and the environment. Sustainable textiles are typically long-lasting and robust. When their life cycle comes to an end, they are frequently made to be recycled or reused.

United Nations Member states adopted the 2030 Agenda for Sustainable Development in 2015, with area of focus on environment, social, and governance. One of the goals adopted by United Nations that will help to achieve the agenda by 2030 is responsible consumption and production. Unsustainable consumption and production pattern have been identified as the main cause of negatively planetary effects of biodiversity loss, climate change, and pollution. Fabric production and consumption pattern has been identified as one of the most environmentally destructive sectors of the global economy. This is because according to Swarna, (2023) the textile industry contributes significantly to global warming, emitting 1.7 million tonnes of CO2 per year, which accounts for 10% of worldwide greenhouse gas emissions.

Fabrics can be made using a variety of techniques, including felting, tufting, bonding, knitting, crocheting, and weaving. But out of all of these methods, crocheting is among the most environmentally friendly ways to produce fabric. This is due to the fact that a variety of yarns, including those derived from sustainable materials like bamboo, hemp, and recycled materials, as well as natural fibers like cotton, linen, and wool, can be used for crocheting. Additionally, the crochet method of fabric creation uses very little energy because it is typically done by hand, leaving no carbon imprint. That is why fabric manufactured using the crochet technique is also categorized as slow fashion. Unlike the machine produced fast fashion that is mass produced, crocheting allows the designer to showcase creative ingenuity in creating unique customized item.

Statement of problem

When it comes to the sustainability of fabrics, researchers frequently pay more attention to the materials than the processes involved in producing fabrics. The textile business releases hazardous chemicals and waste water into the environment during the production of conventional fabrics, which pollutes the environment. One of the sectors of the global economy that has been shown to have the greatest environmental damage is the textile manufacturing sector. The textile industry contributes significantly to global warming, emitting 1.7 million tonnes of CO2 per year, accounting for 10% of worldwide greenhouse gas emissions (Swarna, 2023). As a result, industrialized countries are gradually changing the way they produce textiles in response to growing public awareness of sustainable manufacturing techniques. Regrettably, Nigeria continues to lag behind in terms of sustainable fabric awareness. Due to this, the nation has become a dump for various fast fashion textiles. Consequently, the goal of this study is to investigate crocheting as a sustainable fabric production method that provides an innovative substitute for traditional textile manufacturing techniques.

Purpose of the study

The aim of the study is to promote environmental friendly method of fabric production through the crochet technique and to encourage its exploration in Nigeria. The aim was accomplished by achieving the following objectives:

1. Highlighting ways crochet technique of fabric production agrees with the principles of sustainability
2. Presenting successful cases of sustainable fabric made with crocheting techniques.
3. Examining sustainable crocheted materials' economic viability and potentials.

Significance of the Study

The achievement of this research provides fabric designers with a more environmentally friendly technique which could be used to produce durable fabrics. It can also be used to add embellishment to fabrics created using other techniques. Fabric designers can experiment with various stitches, patterns, and colors, allowing for unique and personalized designs that cater for individual tastes and preferences

Methodology

The study is a qualitative research that employed exploratory and descriptive research methods. Data for the study were collected from primary and secondary sources. The primary data was sourced from personal experience such as creating crotchet shawl, table cloth, crochet rug and observations of students practical works on crocheting. While the secondary data was sourced from textbooks, journals and articles relevant to the topic.

Literature Review

The conceptual frame work for the study is based on the following areas of interest:

Sustainable fabric manufacturing.

Nayak, R., Panwar, T., Grover, T., and Signh, A. (2024) in a recent study stated that the three pillars of sustainability are breached in the supply chain process of clothing and textiles. the study listed environmental pollution, excessive resource use, generation of large amount of waste, greenhouse gas generation, excessive chemical use, child labour and forced labour as some of the problems associated with the manufacturing of clothing and textiles. However, study went further to look at the various approaches that could be implemented in manufacturing of clothing and textile to make it more sustainable. Some of the approaches that was examined during the course of the study were the use of newer technologies such as laser, RFID (Radio Frequency Identification), carbon dioxide dyeing, air dyeing, ozone applications: use of eco- friendly processes; and waste management to reduce environmental impacts. The approaches adopted during sewing operations such as energy saving and waste management were also discussed.

Swarna, (2023) in a study described sustainable textile manufacturing as the process of making textiles using environmentally friendly practices that reduce waste and pollution. This may entail the use of recycled materials like polyester derived from used plastic bottles as well as natural fibers like cotton, hemp, and linen. Apart from using less energy and water, sustainable textile production also uses fewer hazardous chemicals. According to Swarna, (2023) One of the primary advantages of sustainable fabric manufacturing is that it has a substantially smaller environmental impact. Wholesale fabric online manufacturers can considerably minimize their carbon impact by utilizing recycled and natural fibers. Also, they can lessen the amount of pollution produced throughout the production process by using less energy, water, and toxic chemicals.

Bjorkdahl (2022) in a study cited (Ellen MacArthur Foundation) as having noted that in terms of environmental responsibility, sustainability is “embedded” in a substantial part of the West African Textile & Clothing industry. This includes both general sustainable practices and circularity. Firstly, traditional practices of hand weaving and hand-dyeing textiles in West Africa are slow, promoting longevity and quality garments. Made-to-order clothing is also commonplace in African countries - a natural way to mitigate unsustainable production, by ensuring quality and a personal connection to garments. Bjorkdahl further noted that circular practices such as remaking and repairing which many industrialized countries are trying to implement have for a long time been common practice among tailors, designers, and artisans in Africa. Bjorkdahl asserted that clothing production in Africa has often been characterized by sustainable practices.

Patti, Cicala, and Acierno, (2020) in a study reviewed eco-sustainability of the textile manufacturing process, highlighting current issues related to the environmental concerns of the textile productions. In providing alternative solutions for limiting the production of solid textile waste to be disposed, reviewed studies that dealt with the possible applications of the

recycled fibers, coming from textile waste, into the world of composite materials. In particular, recycled fibers, mostly based on cotton, were added in thermosetting resins as reinforcement for structural applications, also with the intent to replace the traditional harmful glass fibers. In the thermoplastics, recycled cotton was introduced for obtaining a reinforcing effect in view of automotive components, while the silk and wool were applied for their insulating features in view of printed circuit boards. The idea of reusing of industrial textile waste, or recovery of used fabrics, for realizing recycled fibers, are all centered on sustainable manufacturing practices. This will reduce the use of new raw material with its resultant harmful and toxic chemicals released to the environment during the manufacturing process. Patwary, (2020) In a study investigated the environmental challenges of the Clothing and Textile industry and explores pathways towards a more sustainable production and consumption. It was highlighted that different stages of textile and clothing lifecycles have a different level of environmental impact. For example, the cultivation of natural fibers consumes a large amount of freshwater, whereas yarn and fabric manufacturing consumes a vast amount of energy. Similarly, not all textile fibers have a similar level of life cycle impact. For instance, a cotton fiber consumes a vast amount of water to grow and be processed, whereas a polyester fiber consumes a significant amount of energy during its production. As a result, considering water issues, cotton is worse than polyester; however, polyester would be worse when considering energy issues. Considering all the life cycle stages, a polyester-made product has about double the carbon footprint of that of a cotton-made product (Patwary, 2020) Patwary also identified other impact categories besides carbon footprint for example, acidification, eutrophication, ozone layer depletion, toxicity to humans etc. Therefore, concluded that it is difficult to compare between different fibers and different stages without assessing their whole life cycle impact in a comparable system boundary, unit, and impact category.

Crochet

Crocheting is a handmade technique of looping yarns with hooked needle to produce patterned fabrics. The looped structures that distinguish the modern crafts of knitting and crochet are distinguished by different textile classification systems, claims Cary (2018). Nevertheless, no distinction was made in printed materials before the early nineteenth century. References to what is now known as crochet were hidden when the fabric of either construction was labeled as knitting. The word "crochet," according to Araya (2022) citing Reed, comes from the French word "Croches or Croc," which means hook. A single continuous yarn is used in crochet to produce an interwoven fabric structure.

It is not known exactly when crochet began as a craft or art form, but it is assumed that the practice dates back a few hundred years. Mildred (1979) notes that a lacy type of crocheting considered as a form of American lace was popular in the sixteenth century. Marks (1997) affirms this assertion by quoting Annie Potter an American crotchet expert who stated that the sixteenth century saw the development of the actual crocheting craft as we know it today. Some schools of thought contend that it originated with Chinese stitching, an extremely old style of embroidery that was practiced in North Africa, Turkey, India, and Persia. However, there is no concrete proof that the art was practiced before to the 19th century, when it became popular in Europe. The popularity of crocheting as a technique of fabric production has fluctuated over time, but it appears to have gain popularity in recent times. This is because advancement in modern technology has made it possible for crochet designers to share their techniques and successful works on the social media reaching a larger audience. Moreover, the campaign about sustainable fabric manufacturing practice must have contributed to the recent surge of interest in crocheting.

The fact that crocheted cloth can only be made with hand tools is one of its peculiarities. A crochet hook and yarns are

all that are needed to make a crocheted fabric. This makes it appropriate for testing yarns made from recycled or natural fibers to lessen the impact of fabric manufacture on the environment. Additionally, because crochet materials are primarily handmade, the artist is able to create fabrics that are more long-lasting and durable, which promotes slow fashion and a more sustainable approach to fashion.

It has been suggested that crochet can also play a role in promoting positive wellbeing in the general population. Burns and Van Der Meer (2020) in a study investigated the impact of crocheting on individuals 'wellbeing using an online survey based on an existing tool that explored knitting and wellbeing with about 8391 respondents living in 87 different countries. After analyzing the results of the survey, reached the conclusion that crochet offers positive benefits for personal wellbeing. Because many respondents indicated having actively used crochet to manage mental health conditions and life events such as grief, chronic illness and pain. In a related study York, Zhang, Yang, and Muthukumar, (2022) examined how crochet that was embedded in STEAM summer camp impacted students sense of belonging, creativity, well-being and STEAM learning. The study carried out a survey using 37 student participants. Findings from the survey indicated that crocheting enhanced students sense of belonging, creativity and well-being as well as STEAM learning.

In order to provide a theoretical explanation for the study, the theoretical framework work will be based on two chosen theories that are pertinent to the investigation. McDonough's "Design for Sustainability" and the Slow Fashion movement are two of these.

The "Design for Sustainability" book by McDonough offers a starting point for examining how crocheting fits into sustainable design principles. The idea frequently highlights limiting negative effects on the environment, taking social factors into account, and encouraging moral design practices. and the Slow Fashion movement promotes a more ethical and environmentally friendly method of producing textiles and clothing. An examination of how crocheting promotes the ideas of slower, more deliberate manufacturing, prioritizing quality over quantity, and reducing environmental effect is made possible by basing the paper on this trend

The mass production of fast fashion with cheap materials, usually have a devastating effect on the environment. one of the creative solution that seeks to reduce the misuse, waste, and ecological harm of fast fashion is crotchet slow fashion. Because crocheting entails crafting of clothing and accessories deliberately at a pace that considers the interest of the designer as well as the environment. Since it is usually made with hands, it enables each designer to explore the creative ingenuity in producing unique pieces that can be truly one of a kind.

Ways crochet technique of fabric manufacturing fits into the principles of sustainability

Crocheting, as a sustainable fabric manufacturing technique comprises of several features that makes it an environmental friendly method of fabric production.

1. Lower environmental impact: because crocheting is majorly handmade, it leaves no carbon foot print. Therefore, not harmful to the environment.
2. Facilitates reuse and recycling: old used or damaged fabrics can be turned into new beautiful useful material using the crotchet technique. Old knitted or crochet sweater can be loosed and the yarns reused for the production of new crotchet item. This way waste fabrics that would have been disposed by burning or deposited in landfill can be recycled. Crochet is not only a way of giving new life to old fabrics, but resources that would have been used in producing new raw materials are also saved.
3. Enables upcycling of old clothes: old clothes can be enhanced by attaching

some crochet details. For instance, attaching crochet sleeves to sleeves gown, attaching crochet collar to coats or shirts, attaching crochet scallops to skirts among others. Torn fabrics can also be repaired by covering the damaged part with crochet design.

4. Allows for the creation of customized items: it enables one to create unique and quality materials that are more durable instead of constantly buying new clothes or accessories. Even with regular use and washing crocheted materials last long. Because crocheting is often handmade, preference is given to quality over quantity unlike mass produced fast fashion materials that are not durable.
5. Crocheting allows great degree of design flexibility and creativity: designers can explore different stitches, patterns and colour in the same project that takes care of individual customers tastes and preference unlike automated machine produced fabrics that are mass produced. Crochet displays the individual designer's artistry and attention to detail.
6. Adaptability: crocheting techniques can be used for the production of variety of items such as apparels, fashion accessories, home decorations items among others. The adaptable nature of crochet technique enables the production of multi- functional products that fulfills different needs, thus reducing the need for constant purchasing of new products.
7. Comprehensive manufacturing: Without the need for extra input, fabric can be made with crocheting, starting from yarn and ending with finished goods. For instance, you don't need to use a machine or needle to sew when making a crocheted skirt or sweater from yarn to finished item.

Basic crotchet Stitches, abbreviation and how they can be achieved

Ch – Chain stitch; to achieve this make a slip knot, insert hook, take yarn over, draw yarn through loop. Repeat from same for each additional chain until the desired length is obtained

Sc –Single crotchet stitch; to achieve with the crochet hook in right hand, make a slip knot on the hook. Yo from back to front and grab it with the hook. Draw hooked yarn through slip knot and onto hook, skip the first chain stitch, insert hook into center next chain stitch, yo and draw loop through (1sc is made)

Dc – Double crochet; to achieve insert hook into next st, yo and draw loop through, yo and draw this loop through the 2 loops on the hook, (1dc is made)

Hdc –Half double crochet; to achieve yo, insert the hook under top loops of the next stitch. Yo pull yarn through stitch to draw up a loop. There should be three loops on the hook, yo, pull the yarn through all three loops on the hook.

Tr – Treble crochet; to achieve yo, insert hook into next st, yo and draw loop through, repeat yo and draw this loop through 2 of the loops already on the hook, repeat from yo once more, (1tr made)

H tr – Half treble; to achieve yo, insert hook into the next st, yo and draw loop through, yo and draw this loop through all 3 loops on hook (1h tr made)

F sc – Foundation single crochet; to achieve make a slip knot on the crochet hook, then Ch 2. Insert hook in to the first chain stitch, yo and pull up one loop, yo and pull the yarn through the first loop on the hook, yo and pull through both of the loops on the hook (1 single crochet is made

F ptr –Front post treble crochet; to achieve Yo 2times. Insert crochet hook from back to front again around the post of the stitch on the previous row. Pull up a loop, yo. Pull through the 2 loops on the crotchet hook, yo. Pull through 2 loops on crotchet hook, yo. Pull through the last 2 loops on the crochet

hook. These steps will be repeated in order to create another ftont post treble crochet.

Slst – Slip stitch to achieve insert hook into next st, yo and draw loop on hook(1dc made)

Sk – Skip

Yo – yarn over

Rep – Repeat

St – Stitch

Steps for Creating Diamond Stitch Crochet

Step 1: With your crochet hook and yarn make a chain of 33

Step 2: In Row1; insert the hook in the 2nd Ch from the hook make 1Sc, continue making 1Sc into the foundation chain until all the chains are exhausted.

Step 3: In Row 2; Ch 2, turn, make 1Dc in each of the stitch all through

Step 4: In Row 3; Ch 1, turn fptr around third Sc of row 1, repeat Sc in the next 3 sts, fptr around last stitch worked, skip Sc sts and fptr around next Sc st. Repeat from to the end. Sc in next sts, fptr around last fptr worked, place Sc in turning Ch2.

Step 5: In Row 4; Repeat crochet work on row 2

Step 6: In Row 5; Ch 1, turn, Sc in the first 2 sts, fptr around first and next fptr, repeat Sc in next 3 sts, fptr around last fptr worked next fptr. Rep from to the end Sc in last 3 sts.

Step 7: In Row 6: Repeat crochet work on row 2

Step 8: In Row 7: Ch 1, turn, fptr around first fptr, repeat Sc in the next 3sts, fptr aroud last fptr worked and next fptr. Repeat to end. Sc in next 3 sts, fptr around last fptr worked, place Sc in turning Ch 2.

Step 9: For the rest of the Rows: repeat rows 4 to 7 until the desired length is achieved to get one side of the fabric. These steps were repeated to get the second part of the fabric.

Step 10. With you crochet hook and yarn make a chain of 15 repeat the stiches in row 2-5 to a width of 10inches and bind off. This step is repeated to get to get the second part of the fabric that will be used for the hand.

Step 11: The two sides of the crocheted fabrics are seamed and the hand attached. See plate 1a for the finished work.

Procedures for Creating Crochet shawl

Step 1: With your crochet hook and yarn make a chain of 300

Step 2: In Row1; work (1dc,2ch,3tr) into 2nd ch from the hook. Skip 4 ch, work (1dc,2ch,3tr)
into the next ch; repeat from beginning to end.

Step 3: Pattern Row; 2ch, repeat (1dc,2ch,3tr) into 2ch space, repeat from beginning to end.

Step 4: Repeat row 2 pattern until the desired length for the work is obtained. Then fasten off. See plate 2 for finished crochet shawl work. Other examples of finished crocheted items are table clothes in plate 3a and 3b, Granny square pattern crochet bag plate 4a, crocheted bag 4b and crochet rug plate 5.

Examples of successful sustainable fabric produced using crocheting techniques.

Plate 1a: *Diamond stitch crochet gown Student's project (Erekaka, 2022)*

Plate 1b: *Double crochet stitch gown Student's project (Erekaka, 2022)*

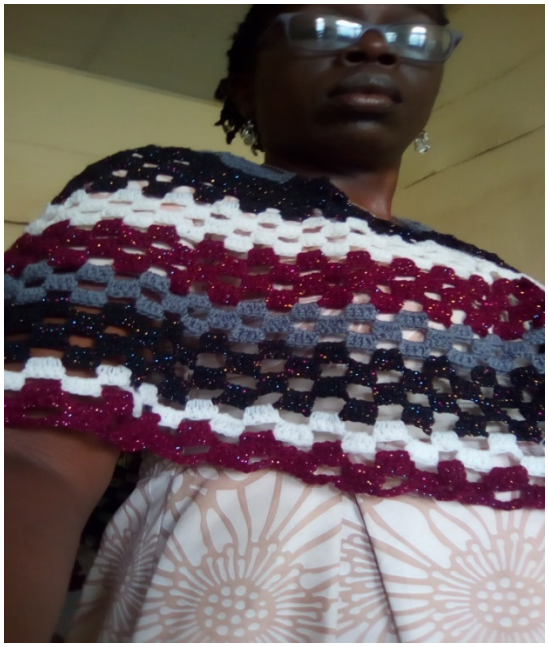

Plate 2*: Crotchet shawl (Source: Okeke 2024)*

Plate 3a: *crotchet Table cloth*

Plate 3b: *crotchet Table cloth*

(Source: Okeke 2024)

Plate 4a: *Granny square pattern crochet bag student's project*

Plate 4b: *Crochet bag*

(Source: Okeke 2024)

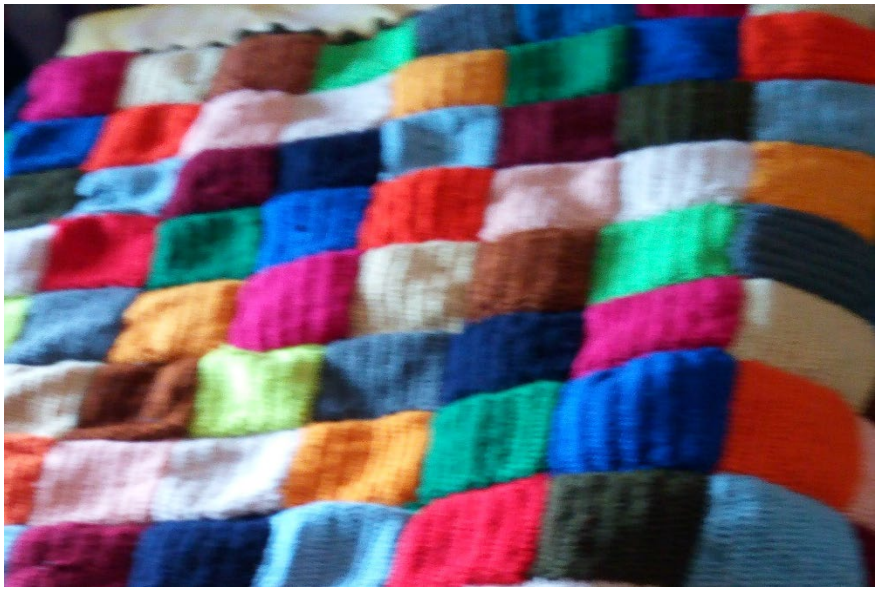

Plate 5: *Crochet Rug (Source: Okeke 2024)*

Economic feasibility and market potential of sustainable crocheted fabrics

1. Given their value and longevity, customers are willing to pay higher prices for fashionable crochet products made of long-lasting materials that are simple to fix.
2. You don't need expensive equipment or a lot of space to practice crocheting. As a small enterprise that can be run from home, it can support indigenous craftsmanship and lessen the carbon impact caused by the conventional fabric supply chain's worldwide distribution. In addition to saving the environment by reducing emissions, recycled materials made with the crochet technique also save waste and conserve resources. When an old clothing is imaginatively repurposed using crocheting, the old cloth gains value and there is less of a need for new products, which also results in cost savings.
3. With the high rate of unemployment and economic meltdown that is being witnessed in country, crocheting skill can create a source of livelihood for the teeming unemployed youths by providing jobs with fair income. Money realized from sales of crochet products can improve their standard of living and create prosperity, thus meeting sustainable development goal 8 which is decent work and economic growth.
4. The environmental effects of the chemicals used in the production of conventional textiles can be lessened by using the crochet technique to manufacture fabrics. It might reduce pollution of the air and water, safeguarding biodiversity and fostering a healthier environment.

Conclusion

Having looked at the various fabric products that can be manufactured using the crochet technique, the study is advocating that textile designers should adopt crocheting as a sustainable technique of production. Because it will enable them create highly quality and durable materials that can reflects individual's preferences while having minimal impact on the environment. It is also not a capital intensive business, consumes little or no energy, thus it can be practiced even in the rural area where there is insufficient power supply. Moreover,

the adaptable nature of the crochet technique makes it suitable for the production of different fabric materials that satisfies different needs such as apparel, fashion accessories, soft furnishing among others. This ensures a ready market for crochet products. There is a possibility of the market expansion for crocheted products as the awareness for the consumption of sustainable fabric increases. So there are great prospects for people who acquire crocheting skill in the upcoming years.

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