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Innovative Scraping Equipment for the Indigenous Leather Tanning Industry in Ghana

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ABSTRACT: Scraping of leather to remove the flesh and hair known as 'fleshing' and 'dehairing' are two of the most important processes required for processing pelt prior to tanning. The indigenous technology used for these activities has remained the same and they are not comfortable and impinge the physical health of the tanner. The research sought to innovatively develop an equipment that can aid in fleshing and defleshing of pelts for the indigenous leather tanner to perform his task in a more comfortable posture. The researchers followed the practice based research approach, where the indigenous process for scraping hair and excess flesh were observed carefully, to detect the shortfalls, andupon whichtwo wooden two scraping equipment with different surface shapes were produced for indigenous tanners. Thetwo equipment were tested and found useful, as the tanners found it more useful and comfortable than what they inherited from their predecessors. The equipment will provide tanners with a more comfortable means offleshing and defleshing of pelt, and also facilitate leather production to meet the needs of leather craftsmen, and ultimately boost the industry.

KEYWORDS: Innovation, Scraping, Equipment, Defleshing, Dehairing, Pelt

I. INTRODUCTION

Leatherwork as an indigenous Ghanaian vocation has been practiced since time immemorial, and its popularity is mostly associated with the indigenous communities in the northern part of the country. In these areas, it serves as one of the major income generation ventures which provides livelihood for many people [1]. After production, many artisans depend on the local leather as primary material to meet diverse demands in making bags, footwear, arm rest, throw pillows and footrest. In the tanning process, pelts of both bigger and smaller animals (goat, sheep and cow) go through several treatments to become leather. Defleshing and dehairing are therefore considered as important activities carried out by tanners to get rid of non-structured proteins, fats, hair and dead proteins, leaving an essential pure collagen matrix for processing to serve as leather with appealing grain surface. It has been observed that in the local tanneries, the beamsters carry out these two crucial processes (defleshing and dehairing) by sitting on tree logs at postures which cause a lot of fatique to their backs as shown in *Plates 1and 2* respectively. Also the pelt being treated get dirty since the two processes are carried out close to the floor. The need for improved approach was found urgent in this study.

Plate 1. *Indigenous process for dehairing.*

Plate 2. *Fleshing process, the same as dehairing.*

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A. Dehairing and Defleshing Techniquesin Indigenous Tanneries

According to [2], before dehairing and defleshing occur in the local tanneries, cured skins are soaked in pure water to eliminate salt, blood, and dirt, and also to replace moisture lost in the curing process. After the skins have gone through the liming process to weaken the excess flesh and hair roots, the flesh is removed by hand with a dull knife. [3] explains further that to lose the hair roots and weaken the excess flesh, the skins are
immersed in a solution of lime and containing a small amount of sodium sulphide. Following this operation, the hair is easily removed by defleshing in the same way as dehairing, and the distinctive pattern known as the grain can be distinguished on the outer surface of the skin. To ensure clear, clean surfaces, any remaining flesh and hair is further scrapped off, this process is known as scudding.

It has been identified that round logs, large pieces of broken pipes or old long mortise are the surfaces on which local tanners carry out dehairing and defleshing [1]. He describes that in the processes, the craftsmen sit on a piece of log and hook the edge of a pelt firmly with the knee to the scraping equipment before the scraping knife is used to work on it, by scudding from the top downward continuously in one direction until the entire surface is covered.This technology causes the craftsmen to be soiled with dirt and the residue of the chemicals used for tanning; and these chemicals when smeared with it for a long time affect the skin of the tanner.

Leather has been described by historians and researchers, as a sheet of material with varying sizes, ranging from tens of square centimetres to six, seven or more square meters,contingent on the animal from which it was obtained. Thomson further stated that until the development of woven textiles, leather was the only stuff available in sheets of this size.According to [4] the high demand for leather called for tanners to go through several processes called tanning to produce leather to serve versatile purposes. The tanning procedure converts the putrescible skin into a durable, long-lasting and resourceful natural material for various uses.

[5] also states that Tanning simply means impregnatingskin and hides with certain chemical reagents called tannins in order to produce leather of high quality. The tanning process converts the putrescent pelt into a long-lasting and adaptable natural material for various uses.[3] also indicates that, together with wood, leather formed the basis of much ancient technology, and that leather manufacturing is one the oldest industrial activities known to humanity. The earliest ancestors usedpeltsfrom animals they could capture to protect their body, hands and feet. Leather as a material is made from the pelt (skin or hide) of any animal, reptile, bird or fish through a process known as tanning. [5] has emphasized that this method preserves the skin, which would have quickly putrefied or decayed. Tanned leather is an animal hide which has been subjected to a chemical process which retards decay. Without tanning or some form of treatment, the skins will rot and become putrid, making them useless for any application other than being disgusting.
The indigenous Leatherwork industries have carved great images for themselves as a result of the immense benefit society has gained from them over the years, in terms of employment and processed leathers and finished products required to meet some basic household, religious and traditional needs. However, the technology for processing leather from its primary state after skinning to tanning have remained the same, indigenous craftsmen use the vegetable tanning technique, primarily liquid extracts from plants such as pawpaw leaves and pumpkins as well as wood ash and lime have been used, but these still leave some of the hair intact hence the need for mechanical action to complement the action, according to [6] vegetable tanning utilises extracts from the bark of various trees and seedlings as tanning agent. In order to achieve a better finished work, indigenous craftsmen use direct physical efforts to dehair and deflesh pelts. [4] explains dehairing as to deprive of hair and specifically to remove the hair or wool from (hide and skin). He furtherexplains that deflesh means to remove the flesh. In the area of leather processing, the raw skin being converted usually contains subcutaneous tissues which are not needed in the resulting leather, defleshing therefore aims at removal of excess/loose meat found on the stocks of leather to help to remove all the fat, excess flesh and gristle from pelt. As shown in figures 1 and 2, dehairing and defleshing on wooden boards have been core part of beamhouse operations from indigenous era as shown in *figures 1 and 2*.

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Figure 1

Figure 2

Figures 1 and 2:*Historical Scraping approaches to dehairing and defleshing (Source: Leatherresource.com)*

Traditionally most indigenous and small scale tanners use wood as support for detailing and fleshing, the wood may be used in the form of log or board in either case it should enable to achieve the removal of flesh and hair from the pelt as required. Wood, according to [6] is an organic material, a natural composite of cellulose fibres embedded in a matrix of lignin which resists compression. In his view, [3] has explained that the nature of pelt scraping processes make it convenient for the use of strong and heavy wood which can withstand the vigorous activates of hair and flesh scraping and be used for longer period of time.

The postures by which these activities are performed affect the physical condition of the beam-star. As observed by [1] the continuous bending posture of tanners affects their back bones, they are therefore not able to stand upright in the normal human posture (they secure scoliosis, and other vertebral problems), productivity is thus hindered. He further proposed that considering the potential benefits derived from the indigenous tanning industry and the need to lessen the overriding hardship the craftsmen go through in their work, the need to evolve indigenous based technological innovations that would be acceptable to the people and help in surging the industry forward was crucial.

According to [7], innovation is a new idea, device, or method: the act or method of evolving new ideas, devices, or methods. Innovation can be viewed as the practical application of better solutions that meet new requirements in articulated needs, or existing market needs.[8] has also emphasized that innovation concepts when properly applied to already existing ideas, methods or products can result in more effective products, processes, services, technologies, or ideas that are readily available to society**.** [9] have statedthat innovation is the local knowledge that is exceptional to a given culture or society. Thus the desire to provide an innovative equipment for use by local tanners is supported by history, where the requirement to speed up the tanning process, resulting from growing demand for leather, caused the industry to undergo quick automation of the manufacturing process during the industrial revolution [6]. Consequently, the idea of innovatively improving the concept, processes and techniques in leather making led to the automation and mechanization of leather processing technologies[10].In the view of the researchers, this pursuance is vital since innovative approaches to improving existing methods is prerequisite to improved productivity and quality standards in an existing industry.

With the ultimate intention of improving the existing dehairing and defleshing approaches used by tanners in the local leather industry,the researchers took into consideration the previous knowledge and experiences of the local tanners in the design and production of two scrapping equipment: one flat surface and the other convex surface.

II. MATERIALS AND METHODS

The researcher produced two separate Scraping Equipment and these were classified as project One and Two; in pursuance of this, the Observational, Descriptive and Experimental and Qualitative Research Methodologies used, with the view to finding alternate technology to promote the scraping activities of dehairing and fleshing as performed by

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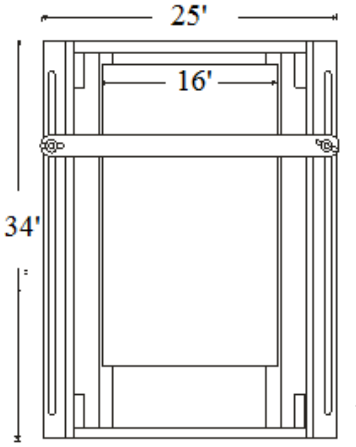
the indigenous tanners. Efforts were made to understand the technology used by the local tanners so as to research and produce one that is technically and ergonomically relevant for its purpose.

B. Project One: Designing and Production Process of Flat Surface Scraping Device

Initial drawings consist of a trough with four legs; two of the legs at one end are made shorter than the other two and this result in having the trough tilted. The trough has a flat board raised above it, and it has open space all around it a seat is created at the upper side and a receptacle at the lower end to take the residue.



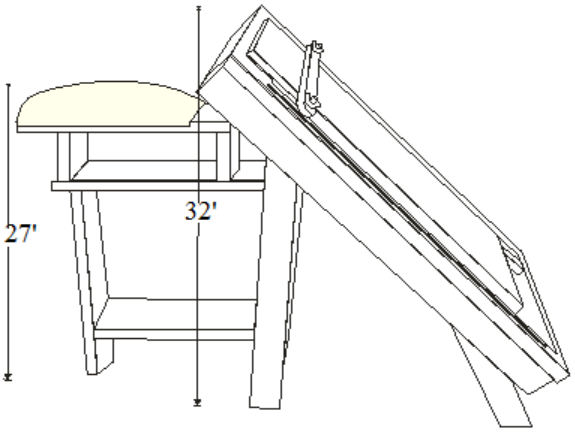


Figure 2: ***Figure 3:***

Figures 2 and 3: Lineal drawing of scrapping equipment showing the seating and working and
(Source: Two Dimensional drawings made by researchers after observing their methods)

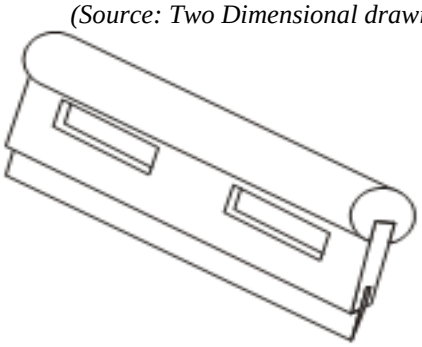


Figure 4:*Two Dimensional design of Scrapping blade (blunt) for dehairing and defleshing*
(Source: Drawing of scraping blade designed after field observations)

C. Development and Rendering of Designs in Three-Dimensional Representations

By using the Rhinoceros application software programme, the two-dimensional linear drawings were converted into three-dimensional images to show the wooden effect of the flat surface scraping equipment, andto give fair idea of its looks upon completion.

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Figure 5:*Three-quarter view of the flat surface scrapping equipment*.

Figure 6. *Side view of the flat surface scraping equipment.*

Materials and Tools: Sanding sealer**,** ii. Sandpapers**,** Acrylic paint**,** ½ inch Plywood The tools used included hammer, pincers, square, plane, saw, nail, tape measure, orbit fun, sanding machines**,** planning machine**,** combined sawing surfacing and mortise.

D. Construction Processfor Project One:Flat Surface Scraping Equipment

Step 1: The various parts of the equipment were cut to sizes and assembled. Firstly, the top frame that support the scraping board was formed, it had a groove at each end through which a wooden fastener moves up and down, (plate 63). The fastener is meant to hold the pelt firmly on the scrappingboard during dehairing or fleshing, (plate 64).
Step 2: The scraping board is produced by joining two pieces of wood together sideways to from a single broad surface (plate 66). This was next planed and made ready to be fixed on the scrapping frame.

Plate 3:*The slotsand the upper frame.* ***Plate 4:*** *Fully fixed frame*

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Plate 5: *The finished project* ***Plate 6:****Working with the equipment*

E. Project Two: Designing and Production Process Convex Surface Scraping Device

Following after the lineal representation as in project One, the researchers produced second equipment that has a curved surface area (convex) for fleshing and dehairing.

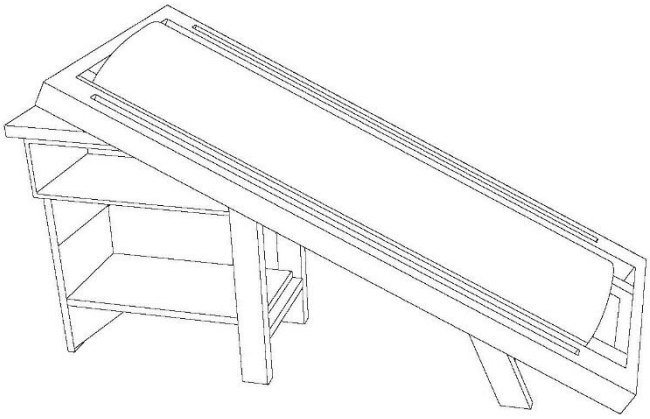

Figure 7*: Presentation of the views of designs for project two*

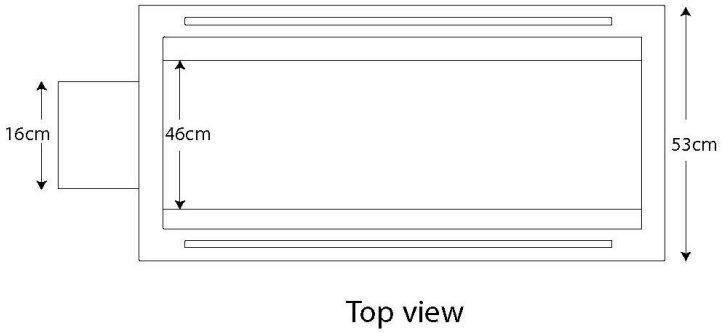

Figure 8*: Presentation of the views of designs for project two*

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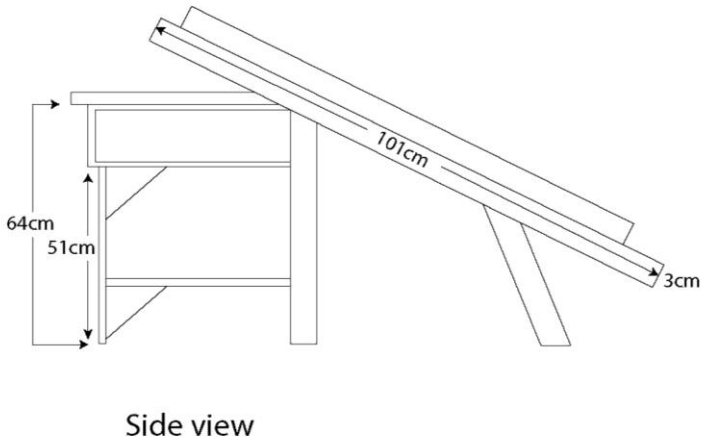

Figure 9: *Presentation of the views of designs for project two*

F. Development and Rendering of Designs in Three-Dimensional Representations

Following after the lineal representation as in project two, the researchers used the Rhinoceros application software programme to render the Convex surface scraping equipment into a three-dimensional image to simulate its appearance upon completion.

Figure 10:**Views of** *three-dimensional representation of the convex surface scraping equipment*

G. **Construction Processof Project Two: Convex Surface Scraping Device**

Plate 7. Side view **Plate 8.** Frontal view

Plates 7 and 8: *Views of the finished convex surface scrapingequipment*

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A lot of designing and sketching was done till the final design was arrived at. Working drawings with dimensions were done and materials were secured for execution. Construction begun.Construction begun by seasoning of woodHaving completed the seasoning process, the wood was cut into the required shapes and sizes, and the convex frame was the first to be constructed.The front and the back stands were then constructed. They were fabricated to the requested height to help us achieve the required posture.

The seat was then constructed and finally, the surface was constructed from a beam of wood (Mahogany). The parts were assembled to obtain the final form of the scudding equipment. In finishing, when the parts were constructed, they were sanded with 80,120and 160 sand papers. Sanding sealer was applied and sanded again with emery paper.The equipment was sprayed to gain some amount of water resistance.

III. RESULTS AND DISCUSSION

The discussion has been presented based on the two projects which the researchers embarked upon. The discussion pays attention to the outcome of the constructional process, as well as the technical components which function to ensure adequate support to tanners for effective scrapping of hair and excess flesh from pelt during the beamhouse process of cleaning.

H. Project One: Flat Surface Scraping Equipment

Wood is the main material used to construct the scraping equipment; since it is largely available in the country it will be easy for one to acquire it. Besides, the design is simple such that any local furniture maker would be able to reproduce it. The bolts and nuts were manufactured at the local lathe-turner's workshop. There will be no difficulty in moving it from one place to another because of its compactness and size. The receptacle provided also enable students to work both indoors and outdoors without making the studio, workshop or tannery dirty. It will help in the teaching and learning of defleshing and dehairing as topics in the Leatherwork syllabus in Ghanaian schools.
The researchers, fiveLeatherwork students and five tanners from an indigenous tannery at Asawase, a suburb of Kumasi, Ghana, tested the efficiency of the device. Reports from all of them were positive: the device was found to be comfortable to use and made scudding easier and faster. Although the primary objective for the equipment was for fleshing and dehairing, it was realized that it could also be used to hold leathers firmly to make sanding and burnishing easier.It is worthy to note that during the period of trials, the flat surface equipment was found to be useful in serving as support whenever the tanners and students wanted to perform manual sanding and burnishing alternatively, and this was done by holding the leathers firmly with the top holder for effective movement of the sanding block or burnishing tool from top to bottom until the required results were achieved.

This equipment marks a departure from the known indigenous technology for scraping which involves defleshing and dehairing, and confirms the earlier definition on innovation by [8]that it is something original and more operative intended to influence the society.

I. Project Two: Convex Surface Scraping Equipment

The use of the rhino software for idea development enhanced the understanding of working drawings and supported fabrication processes. In the cause of the construction of the equipment some parts of the wood
warped due to inadequate seasoning and had to be replaced. Through literature reviewed and visits to the tanneries, it's been realized that the scudding equipment is an enhancement of existing technologies
When testing the equipment, the researchers realized that the convex surface made working easier and very effective. The four legs of the equipment made it very firm so no matter the pressure exerted whiles scrapping, the equipment did not shake. It was also realized that the aluminium plate on the scrapping surface will make the equipment last since the water involved in the process, run of the surface and was not soaked by the wood. This equipment has a very comfortable seating and it gives the worker a good working posture.

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IV. CONCLUSIONS

J. Project One: Flat Surface Scraping Equipment

With the production of the multi-purpose leather detailing and defleshing equipment, indigenous leather workers in Ghana will get access to a leather processing device that can be replicated easily with locally available raw materials without much difficulty, and at a minimum cost. The use of the device will result in upsurge of the production of quality leathers at faster rate; it will also make it possible for tanning activities to be taught in schools and colleges. The device will make it possible for many school graduates to engage themselves in the tanning business for national development.

K. Project Two: Convex Surface Scraping Device

This project has provided a level of improvement on the performance of the scrapping equipment already available. The absence of some basic materials for the project posed a major threat that resulted in many delays in the construction process. This adversely affected the rate of progress of the construction of the scrapping equipment since had to travel quite long distance to secure needed materials.The seat of the device is also padded to provide comfort whiles working.

Designing and execution of this project work is an achievement for Ghanaian indigenous leather tanners who basically produce leather through crude methods which limit productivity and cause various body posture problems. Additionally, in one way or the other the flat surface scraping equipment developed is going to redeem many leather students from the task of sanding their leathers before using them for academic activities.The two equipment will be beneficial primarily to the booth academia (Leatherwork students) and industry(leather craftsmen).

V. RECOMMENDATIONS

Since the equipment are made through simple carpentry construction methods, local carpenters should be traineto develop the competence to produce them for tanners to support dehairing and defleshing activities.
It also recommended that training should be given to the indigenous tanners to acquire the technical know-how prerequisite to use the equipment effectively.

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