

Groundnut; Manual shelling and Hand Operation Sheller: Existing Situation and Future Prospects

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Abstract-- Groundnut is popular crop for its versatile usage including direct consumption as a dry fruit and the production of oil as it has an important nutritional value for human and animal consumption in the form of silage, hay, oil seed cake, Abu Saad et al (2025). This study aims to explore the traditional and intermediate methods for shelling groundnut in Kordufan Region as rainfed small farms zone. Groundnut is grown on small farms in sandy and sandy loam soils in Kordufan region. Lack of groundnut threshing machines at affordable cost, is one of the major future challenges of groundnut production in Sudan. The groundnut Sheller machines available in the market are motorized, complicated and costly and not suitable for small quantities. The hand operated machine fabricated by locally trained blacksmiths, composes of Hopper, Crushing Chamber, Separating Chamber and Blower, M. A. HOQUE et al (2018). Groundnut known as peanut, is a vital oilseed crop that has significantly contributed as food component and cash crop. The study delves into the major milestones, including the introduction of groundnut manual shelling machine by international fund for agricultural development (IFAD) through EN-nahoud Cooperative Credit Project (ENCCP) in West Kordufan State, manufactured by local trained blacksmiths. Peanut manual shelling machine is used to remove the shell of peanuts, use the rolling and peeling method, Xuan Lia et al (2025). Groundnut shelling machine uses to separate shells and kernels with high-efficiency, without damage to the kernel, whereas the shelling rate ranged between 85 -90%, while the breaking rate is 10-15%. Additionally, it addresses the hand labor challenges faced by groundnut producers, which resulted from reluctance of youth labors due to the emergence of new attractive alternatives such as mining and migration to neighboring countries Hoque, M. A. et al (2018). The results highlight the necessity of continuing research for modification, and the implementation of appropriate mechanism in order to guarantee the sustainability and financial viability of groundnut farming in rural areas. The review underscores the urgency of coordinated policy efforts and technical support to mitigate the adverse impacts of cost and scarcity of hand labors, providing pathway for recovery initiatives for sustainable development and stability in Sudan, Elgali, M. B. et al (2022).

Keywords-- Groundnut, Hand labors, Manual Sheller, Small Farming.

I. INTRODUCTION

Traditional agriculture played an important role in achieving food security by increasing food production and providing employment opportunities in the rural areas in developing countries. Sudan is a top-five global producer of groundnut, accounting for 14% of world production, with agriculture, grown mostly under rain-fed conditions Adil H et al (2020). Groundnut is one of the most common cash and subsistence crops in arid and semi-arid savanna zone in Sudan as general and particularly in Kordufan and Darfur regions. The groundnut farming is one of the profitable agricultural activities due to increase demand for nutritious seed and quality of cooking oil derived from the seeds. Groundnut cultivation covers nearly 35% of the total cash crops area in Sudan as major source of foreign exchange and livelihood for farmers, Elgali M. B. et al (2022). Shelling is one of the important processes involved in the production of groundnut and separation of the seed from its pod by impact action, compression and shearing or combination of the two methods. Groundnut shelling, traditionally done by hand, is a slow, labor-intensive process with low efficiency. Manual shellers, such as hand-cranked concave devices, are cost-effective alternatives for small-scale farmers, providing 65%–84% efficiency with significantly reduced labor compared to manual hand-shelling, though they often require manual separation of shells and kernels, Ivonne Angelica et al (2025). This study aims to evaluate the performance of hand shelling and small manual machine used to remove shell of groundnut so that farmers can reduce labor cost, production time and gain high profit by shelling the groundnuts. The shelling operation is majorly divided into two, namely: traditional and mechanical methods, which could be by stick beating or pod pressing by hand, whereas, pod pressing is mostly practiced in Sudan considered as inefficient, labor intensive and time-consuming, FAO (2016). Shelling is essential post harvesting operation to prepare groundnut seeds for further processing depending on the utilization of the product. The threshed pods can be boiled, fried, roasted, or eaten raw with other additives.

Groundnut farming serves as source of income and/or livelihood for small scale farmers in Kordufan region. The plant-based protein, higher unsaturated fat content with higher fiber which make them preferable for nutrition enhancement, Habtamu et al (2023).

One of the objectives of sustainable development is to improve agriculture system and raise the productivity of the main crops in rural areas, through increase cultivation, post-harvest processing, improve agricultural methods to increase income for the smallholders, minimize environmental impacts, foster rural development, and ensure resistance to climate change on rural, marginalized and left behind groups, Bernice W. et al (2025). The manual machine has flat iron beaters for threshing peanut pod to speed and improve the threshing capacity with local low-cost available material, durable and easy to maintain hand machine FAO (2016).

II. TRADITIONAL HAND SHELLING

Traditional hand-shelling of groundnuts in the Sudan, whereas, groundnuts separate from its shells by the workers and they simply decoct the groundnut by their fingers and separate from its shell, causes significant physical strain, specifically swelling, bruising, and injury to the thumbs and fingers of workers. This labor-intensive process, often performed by women, leads to injuries from the repetitive pressure required to break the pods, occasionally prompting farmers to soak the pods in water to soften them as stated by Habtamu et al (2023). Hand shelling is tiresome and slow, which contributes to high post-harvest labor burdens. While wetting the pods can lead to a decrease in the quality of the nuts and increased susceptibility to damage as mentioned by Adetola O. et al (2022). Although, mechanical shellers are increasingly used, many smallholder farmers in Sudan still rely on this manual method, which is a major bottleneck in the post-harvest chain. The most common method of shelling is to break the pods and release the kernel by pressing the groundnut between the index finger and thumb (Ugwuoke et al, 2014). Groundnut hand shelling negatively impacts humans primarily through intense dermatological issues, with studies showing dermatitis prevalence up to 98% among workers, due to dust stuck to the groundnut pods. Prolonged manual labor leads to physical injuries like hand cuts, nail disorders and significant psychosocial stress as stated by Jean-Baptiste et al (2017). There is a growing recognition of the vital role that women play as the backbone of agricultural and small-scale processing activities including shelling of groundnut.

Women's empowerment has become central to international development, which emphasizes gender equality as both a human right and a driver of economic growth and sustainable development, but still it's one of the most hard-working jobs for women particularly for pregnant and girls, (Bernice Wadei et al 2025).

Winnowing, Raghtate. et al (2014). The shoe's half-rotary motion shells the pods alongside the screen. The machine can be operated by one labor and achieve 50 to 55 kilograms per hour with about 10 minutes as losing time for feeding and sometimes for adjustment, so its efficient for separate groundnut shells from kernels. The machine is simple and sturdy structure, making it easy to operate and maintain by small unskilled rural farmers. The shelling machine made from high-quality cast iron for ensuring a long lifespan, uses manual leverage to crush the peanuts, allowing shells and kernels to be separated easily. The kernel damage is just 2% with efficiency tend to 95 %. The groundnut sheller comes with a 26.9 x 9.5-inch flexible screen that allows kernels to fall through while capturing shells and ensuring a long lifespan, R.K. Pohane et al (2020). One of unique advantages of hand operated sheller, reduced workload, minimized nut damage, affordability with potential applications for small-scale farmers, home use, and effectiveness as a practical solution for efficient groundnut shelling in rural areas, Vinay B. et al (2024).

III. ADVANTAGE OF GROUNDNUT MANUAL SHELLING MACHINE

Groundnut shelling machine can perform shelling and shells crushing, therefore, its widely used for home and income generation. The machine characterized with high efficiency reaching 95% and purity percentage 90%, R.K. Pohane et al (2020). This groundnut shelling machine made of low-cost materials and high efficiency, so its appropriate choice for users in the rural areas and for small quantities of groundnut, so its effective and economical for small production. The manual sheller also benefits farmers by reducing time and processing costs for both commercial shelling and shelling for seed. Shelling the nuts by hand produces 7-10 kg of shelled nuts per day, whereas the sheller has a capacity of 40 - 50 kg per hour, Moheb et al. (2023). It can potentially increase farmers' incomes. The initial investment can be recovered quickly, often within the first year of commercial shelling, so it could be one of the most visible sources of income to the young unskilled rural people, A. Ravindra, G. et al (2017).



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IV. WORKING PRINCIPLES

Hand-operated groundnut shelling machine facilitate a simple and manual way to separate kernels from their shells. The machine composes of the frame which made of sturdy metal and this provides the base for the machine. Funnel-shaped container at the top holds the groundnuts to be shelled. A semi-circular container, open at the top, within which the arm moves in a horizontal, reciprocating motion while maintaining a constant clearance to ensure a high percentage of pod shells and minimize seed breakage, Raghtate et al (2014). Separator can be a screen or grid that allows the shelled groundnuts to fall through, while the shells are collected elsewhere. Handle is a crank or lever allows the operator to manually apply force to mobilize the shelling mechanism, Kuldeep Panwa et al (2022). In Pinch Shelling, the groundnuts are squeezed between the moving and fixed textured surfaces, cracking the shells. The shelled groundnuts fall through the openings in the separator and are collected in a container below. The shells are typically collected separately or it can together with seeds and separated later. The operator continues moving coming and going the handle until all the groundnuts in the loading tray have been processed. Once the operation is complete, the operator stops cranking and removes any remaining unshelled pods from the loading tray and clean any residual from the machine for the next batch of groundnuts Vinay B. et al (2024). This crop is considered to have great potential for both food and industrial purposes in the tropical regions of Africa. In some parts of Africa, like Nigeria, Uganda, Tanzania, Kenya and Sudan it is used as a source of revenue generation to support rural development. Groundnut shelling machine is hand cranked sheller, efficient, with high yield and Long-lasting durability, for home and small factories. This machine ensures comfort and prevents hand fatigue during operation, providing a user-friendly experience while shelling groundnuts. Also, the sheller designed to withstand frequent use while delivering consistent performance, offering great value and reliability for users.

Groundnut hand-shelling machines often cause significant negative social and economic consequences, including high rates of seed breakage (up to 17.4%) that reduce market value and increase susceptibility to mold. They are frequently inefficient and labor-intensive, leading to low capacity and potential health risks due to physical exertion, Adetola et al (2022).

V. COST ANALYSIS AND DISCUSSION

Hand shelling of groundnut pod is time consuming, tedious and labor intensive. One person can shell about 7kg of pod manually in one day, which mean 6.5 days for one sack of groundnuts and often causes hand fatigue, pain, and skin irritation for workers, so it's less income compared to other working rate. Although, hand-shelling is preferred to select the best seeds for planting, but it is less efficient than machine-shelling for large-scale production. Hand shelling machine made to shell dried groundnuts and uses a specific construction to break the hard shell and kernels with several benefits, including being efficient and affordable Abo-ElQassem S.S (2021). During the last three decades, small farmers intend to use the low-cost manual machine, which shell 45-50kg/hr. and this means seven time the performance of hand shelling. With adequate analysis, the study focuses on analyzing the importance of hand operating machine that fits the requirements of small-scale producers and adding values to the product, Owusu-A. et al (2017). The devices produced good results for dried groundnuts; therefore, it can be stated that the usage of a machine will expand in the next years because of the growing demand for groundnuts in the market, thus hand operating machine is affordable for small farmers, not inexpensive and provides additional benefits. Groundnut hand shelling machines have been used for small investigation because of their limit operating principles and capacity. Although automated machines are good in terms of performance, but it's not suitable for small scall farming due to high cost, Adetola et al (2022). The hand sheller has mechanical damage (5.3–17.4%), the kernels are broken, which makes them harder to sell, reducing the income of farmers, Olufemi A. et al (2022).

VI. RECOMMENDATIONS

The goal of groundnut shelling machines at inception was not only to shell groundnut in a considerable period, but also to maintain optimum productivity. This will require more efforts from researchers and engineers to take into consideration several factors that can improve or decline the productivity of the shelling machines during design, modification and development process. Additionally, using wet groundnuts in the process should be avoided since they have soil on the shells and increase the likelihood of groundnuts being damaged.

The research focuses on creating a machine that meets the needs of small-scale manufacturers using accurate analysis. May the following recommendations are required in the future: -

- a. The government and other concerns should encourage and facilitate investment in agricultural intermediate technology implements to accelerate production and post harvesting operations.
- b. Availability of long-term funding for the implementation of agricultural projects targeting gradual replacing of traditional implements with intermediate technology implements taking into consideration the cost and technical knowhow of the adaptors.
- c. There should be a universal model for measuring the performance evaluation of the machine to help engineers and researchers in identifying areas for improvements.
- d. Researchers should include specification such as the type or variety of groundnut that was used for experiment for easy comparison of machine outputs as varieties are different in components.
- e. Other means of power such as solar power, encouraged in future designs to develop self-propelling shelling machines to serve in remote area lacking access to electricity and fuel.
- f. Meanwhile, the proposed interventions can help bring immediate relief to the millions of Sudanese facing severe food shortages, by strengthening the local production of much-needed staple crops. In addition, these entry points can prepare a path towards urgently-needed structural reforms of Sudan's food production systems. By incentivizing production for local consumption, decentralizing agricultural input provision and implementing risk-sharing models that shield the most vulnerable market players, towards more resilient food systems.

The development process does not mean that the hand shelling is harmful as it could be used in remote areas, rather it means that the modern machines is more competitive globally, and more able to generate profits for the producers and can improve the livelihood of small-scale farmers, Wanglin Ma et al (2026).

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