Development of Computer Controlled Maize Dehusking and Shelling Machine

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I. Executive Summary

Maize is one of Nigeria's most important staple crops, serving as food, livestock feed, and raw material for agro-industries. Despite its significance, post-harvest processing—particularly dehusking and shelling—remains a major bottleneck. Farmers and processors largely rely on manual labor or inefficient tools, resulting in high labor costs, low productivity, and significant post-harvest losses, sometimes up to 75%. Imported industrial shellers exist but are expensive, inaccessible to smallholder farmers, and costly to maintain. This gap underscores the urgent need for an affordable, locally developed solution.

Our proposed innovation is a locally designed and fabricated maize dehusking and shelling machine that integrates both functions in a single and efficient unit. Built from readily available materials, the machine will operate on low power (diesel or electric motor), with a capacity of 300–500 kg/hour, making it suitable for smallholder and medium-scale farmers. Its design emphasizes affordability, durability, and ease of maintenance in rural conditions.

The project is unique because it combines two critical processes—dehusking and shelling—into one compact system, reducing processing time and minimizing losses. It leverages local fabrication expertise, ensuring sustainability, job creation, and independence from costly imports.

The anticipated impact includes:

- At least 75% reduction in maize post-harvest losses.
- Increased productivity and income for farmers.
- Job creation in local fabrication, operation, and maintenance.
- Strengthened indigenous manufacturing and food security in Nigeria.

We are seeking ₦ 10,000,000 in funding to design, prototype, test, and commercialize this innovation over a 12-month period. This project directly supports NASENI's mandate of advancing indigenous technology development, promoting industrialization, and contributing to Nigeria's food security and economic diversification agenda.

Problem Statement

Maize is a fundamental food crop in Nigeria, playing a vital role in the country's agricultural sector. It functions as a primary source of nourishment for a significant portion of the population, in addition to serving as livestock feed and as a raw material for various agro-industrial processes. The importance of maize extends to its contribution to food security and economic stability.

However, a critical challenge in the maize production chain lies in post-harvest processing, particularly in the dehusking and shelling stages. Currently, these processes are predominantly conducted manually or with inefficient tools, which markedly hinders productivity.

The reliance on manual labor not only escalates operational costs but also contributes to considerable post-harvest losses, resulting in a substantial portion of the yield being rendered unusable for consumption or sale. This inefficiency adversely affects overall productivity and diminishes farmers' income, many of whom operate with limited financial resources. There exists a significant opportunity to enhance these processes through investments in modern equipment and comprehensive training for farmers. By integrating technological advancements into post-harvest processing, it is possible to reduce losses and improve profitability, thereby elevating farmers' livelihoods while ensuring a more dependable food supply for the populace.

Proposed Solution

We propose the development of a locally designed and manufactured maize dehusking and shelling machine specifically tailored for smallholder and medium-scale farmers. This innovative solution intends to be affordable, efficient, and scalable, thereby addressing the unique requirements of local agricultural producers. The deployment of this technology is expected to significantly reduce processing time, enabling farmers to process their maize harvests with greater speed and efficiency. The machine will be designed with user-friendliness and ease of maintenance in mind, allowing farmers to operate and service it without requiring extensive technical expertise. Additionally, by minimizing post-harvest losses, this machine will improve the overall efficiency of the maize value chain, thereby enhancing profit margins for producers. By sourcing materials locally and engaging local artisans in the manufacturing process, this initiative aims to stimulate the local economy and foster innovation within the agricultural sector. This endeavor represents an essential advance toward improving food security and economic resilience in rural communities.

Key Innovation/Uniqueness

Unlike imported or industrial-scale machines, this solution will be cost-effective and locally fabricated, making it accessible for rural communities. Its design ensures that it is easy to maintain, promoting sustainability and reducing long-term operational costs. By combining dehusking and shelling functions into a single unit, it enhances operational efficiency while significantly reducing the labor required for these processes. This adaptability to rural conditions means that it can be used in diverse agricultural settings, ultimately helping local farmers increase their productivity. The focus on locally sourced materials further supports community economies and empowers artisans to contribute to agricultural innovation.

Anticipated Impact:

The enhancement of maize processing capacity is pivotal for strengthening food security and improving farmer livelihoods, with the potential to directly benefit at least 10,000 farmers in the first year, reduce post-harvest losses by up to 75 percent, and generate over 20,000 jobs in local

fabrication and agro-processing. These gains empower rural farmers by providing access to efficient processing technologies that increase the proportion of crops utilized, stabilize food prices, and ensure reliable income streams, thereby improving financial well-being and rural livelihoods. At the same time, investment in local manufacturing capacity reduces dependence on imports, fosters self-sufficiency, and enhances regional economic resilience. As these industries expand, they are better positioned to innovate and tailor services to meet specific community needs, which strengthens service delivery and promotes sustainable growth. Collectively, these outcomes contribute to the establishment of a resilient agricultural ecosystem that drives inclusive economic development, empowers communities, and enhances food systems for both producers and consumers.

Total Funding Requested: ₦10,000,000

Project Duration: 12 months

II. Introduction

Organization/Team Overview:

Our team comprises agricultural engineers, local fabricators, and agribusiness experts with proven experience in agricultural mechanization and post-harvest technology. We have previously developed small-scale agro-machines and partnered with farmer cooperatives to improve food processing efficiency.

Alignment with NASENI's Vision and Mission:

This project aligns with NASENI's mandate of promoting indigenous technology, engineering solutions, and industrial development. By designing and fabricating a maize dehusking and shelling machine locally, we directly contribute to NASENI's strategic objectives of **Creation, Collaboration, and Commercialization**, and support Nigeria's food security and industrialization agenda.

Challenge Context:

The NASENI Innovation Challenge emphasizes **agriculture, food manufacturing, and local technology development**. Our innovation addresses these by targeting the maize value chain, which is critical for food security, agro-industrial supply, and employment generation.

III. Problem Statement

Detailed Problem Description:

Nigeria is the largest producer of maize in Africa, with an annual output of over 12 million metric tons. Despite this, maize farmers face severe post-harvest challenges:

- Manual dehusking and shelling are labor-intensive and time-consuming.
- Post-harvest losses can reach up to 75% due to inefficient processing.
- Imported machines are expensive and difficult to maintain.

- Lack of affordable mechanization discourages youth participation in farming.

Target Beneficiaries:

- Smallholder and medium-scale maize farmers.
- Farmer cooperatives and community-based agro-processors.
- Local machine fabricators and SMEs in agricultural mechanization.
- Nigerian households benefiting from more affordable maize products.

Current Solutions & Gaps:
Current solutions include manual processing, simple hand shellers, or imported industrial shellers. Manual and simple tools have low throughput, while industrial machines are costly and inaccessible to small-scale farmers. **The gap is a locally made, affordable, and efficient maize dehusking & shelling machine tailored for Nigerian farmers.**

IV. Project Description & Innovation

Proposed Solution in Detail:

- A compact machine that integrates **maize dehusking and shelling** in one system.
- Operates on low power (diesel/electric motor).
- Designed with **locally available materials** for easy repair and low-cost maintenance.
- Capacity: ~300–500 kg/hour, suitable for smallholder and medium farmers.

Technological Aspect:

- Dual-function mechanism for husk removal and kernel separation.
- Adjustable settings for different maize varieties.
- Ergonomic and safe design.

Uniqueness & Competitive Advantage:

- Combines dehusking and shelling in one unit (rare in local market).
- Affordable and fabricated with local materials.
- Designed for durability and ease of use in rural conditions.

Scalability & Adaptability:

- Can be scaled to larger models for agro-industrial clusters.
- Adaptable for cooperative ownership and hire services.

Goals & Objectives:

- **Goal:** Enhance maize post-harvest processing efficiency in Nigeria through indigenous technology.
- **SMART Objectives:**
    1. Design and prototype a maize dehusking & shelling machine within 6 months.
    2. Conduct pilot testing with at least 50 farmer groups in 30 states.
    3. Train 2000 local fabricators for replication and scaling.
    4. Achieve at least 30% reduction in maize post-harvest losses among users.

Methodology/Approach:

- **Design & Prototyping (Months 1–3):** CAD design, material sourcing, prototype fabrication.
- **Testing & Refinement (Months 4–6):** Field trials, efficiency and durability testing.
- **Deployment (Months 7–9):** Distribution of pilot units to farmer groups.
- **Capacity Building (Months 10–12):** Training fabricators and scaling production.

Feasibility & Risk Mitigation:

- Risks: mechanical failure, adoption resistance, supply chain issues.
- Mitigation: modular design for repair, farmer sensitization, partnership with fabricators.

Sustainability Plan:

- Revenue through machine sales and fabrication training.
- Collaboration with cooperatives for group ownership.
- Potential for franchising local assembly units.

V. Commercialization

Alignment with National Priorities:
Supports Nigeria's goals in **food security, industrialization, and job creation** under the Agricultural Promotion Policy (APP) and Economic Recovery and Growth Plan (ERGP).

Commercialization Strategy:

- **Market Analysis:** Nigeria has ~20 million maize farmers. Majority lack access to affordable machines.

- **Go-to-Market Strategy:** Direct sales to cooperatives, agro-dealers, NGOs, and extension agencies.
- **Business Model:** Fabrication and sales of machines; training services; maintenance contracts.
- **IP Strategy:** Register machine design under patent & industrial design rights.
- **Future Funding:** Explore partnerships with BOI, Bank of Agriculture, and private investors for scaling.

VI. Project Team

- **Project Lead (Engineer):** Engr. Mrs Oni T.A and Engr. Dr Akinribide O.J - Oversees design and technical development.
- **Fabrication Expert:** Engr. Bekunmi Olusegun, Mr Joseph Olayinka Ayeni, Mr Idris Mutiu, and Mr Lawrence Ajayi Supervises workshop and machine building.
- **Agribusiness Specialist:** Engr. Fatunde Samuel and Engr. Haruna Abdulahi -Manages commercialization and market linkages.
- **Field Coordinator:** Engr. Dr Anamu Silas and Engr. Mrs Akinseloyin- Handles pilot testing and farmer training.

Partnerships: Collaboration with local fabrication workshops, agricultural research institutes, and farmer cooperatives.

II. Budget & Justification

Budget Breakdown & Justification

Equipment & Materials	**~~₦~~ 4,200,000**
Fabrication Tools & Workshop Equipment *Welding machines, cutting tools, grinders, measuring instruments*	~~₦~~1,200,000
Machine Components & Raw Materials *Steel sheets, shafts, bearings, pulleys, motors (diesel/electric), fasteners*	~~₦~~2,000,000
Prototype Development Parts (2 units) *Spare parts and consumables for design iteration.*	~~₦~~1,000,000

Prototyping & Testing	**~~₦~~2,000,000**
Prototype Testing (3 States) *Transport, logistics, and field testing with farmer groups*	~~₦~~1,000,000
Performance Evaluation & Refinement	~~₦~~1,000,000

Data collection, modifications, and design optimisation	

Training & Capacity Building	**₦2,000,000**
Fabricator Training (2000 artisans) *Workshops to transfer fabrication skills for replication*	₦1,000,000
Farmer Training & Demonstrations *On-site sensitisation and machine usage workshops*	₦1,000,000

Commercialisation & IP Protection	**₦1,800,000**
Market Awareness Campaigns *Community demonstrations, brochures, and extension service linkages*	₦1,000,000
IP Registration & Legal Fees *Patent filing, industrial design registration*	₦800,000

TOTAL FUNDING REQUESTED: ₦10,000,000

VIII. Monitoring & Evaluation

Evaluation Plan:

- Prototype tested for throughput, efficiency, and durability.
- Farmer adoption measured during pilot.
- Feedback loops for design improvement.

KPIs:

- Number of prototypes developed.
- Number of farmers using machine.
- % reduction in processing time and post-harvest losses.
- Number of jobs created in fabrication and sales.

Data Collection Methods:

- Field surveys, user feedback, machine performance logs.

Reporting:
Quarterly progress reports to NASENI.

IX. Appendices

- Letters of Support from farmer cooperatives.
- Technical design sketches.

- Profiles of project team members.
- Data on maize production and post-harvest challenges in Nigeria.

Conclusion

The proposal on “The Development of Computer Controlled Maize Dehusking & Shelling Machine” aligns most strongly with **Agriculture and Food Manufacturing**, while also intersecting with **Information Technology and Software Development** and **Renewable Energy and Sustainability**. Its contributions include improving food security, enhancing processing efficiency, creating local jobs, and promoting cleaner, technology-driven agro-processing. Indirectly, it also supports sustainable transport, smart city development, and technical capacity relevant to defense and aerospace. Overall, the project represents a multidisciplinary innovation with its core impact centred on advancing agricultural productivity and local manufacturing capacity.