

Harnessing Solar Power to meet the Post-Harvest Processing needs of rural Farmers: A Case Study of Kaduna State

Habiba Ali¹, Safiya Ali², and Yakubu Hosea³

^{1,2} *Sosai Renewable Energies Company*

³ *Department of Animal Science, Faculty of Agriculture, University of Abuja, Abuja, PMB 117*

Abstract—The transition to sustainable and renewable energy sources is critical in agriculture, particularly for post-harvest processing. This study explores the integration of solar power in Kaduna State, Nigeria, a region with abundant sunlight, to enhance post-harvest processing activities. A baseline assessment was conducted by SOSAI Renewable Energies Company, involving 320 farmers, 96 kiosks, and 76 millers across 30 communities. The findings indicate a significant interest in solar-powered solutions due to high fuel costs and limited access to efficient processing machines. The Market Map project onboarded 41 female agro-processors who now have access to credit facilities and solar-powered infrastructure such as dryers and machines. This has reduced operational costs by approximately 50%, increased productivity, and diversified income streams. The introduction of the "Market Map" technology has facilitated market connectivity and empowered agro-processors. The project demonstrates the economic and environmental benefits of adopting solar energy in agricultural processing, contributing to reduced carbon emissions and improved livelihoods in rural Kaduna. SOSAI Renewable Energies Company plans to expand the initiative, enhancing technological solutions and reaching more agro-processors to drive sustainable agricultural development.

Index Terms—renewable energy, solar power, increased productivity, rural development

I. INTRODUCTION

In recent years, there has been a growing global awareness of the need to transition towards sustainable and renewable energy sources. One sector where this transition can have a profound impact is agriculture, particularly in post-harvest processing (IRENA, 2022).

Numerous studies emphasize the vast potential of solar energy in agricultural settings. The work by Koirala et al. (2019) highlights that solar power, with its renewable and clean attributes, can play a pivotal role in meeting the energy demands of various agricultural processes. This is particularly relevant in regions like Kaduna State, where abundant sunlight makes solar energy a viable and sustainable option for post-harvest processing (Adedeji et al., 2023).

Solar power presents a sustainable and reliable alternative for meeting the energy needs of post-harvest processing in Kaduna State. The region enjoys abundant sunlight throughout the year, making solar energy an ideal choice. The installation of solar panels for electricity generation can power various processing activities, including drying of crops, milling, and preservation (Olayide and Heidhues, 2020).

The integration of solar power into post-harvest processing activities is gaining increasing attention as a sustainable solution to address the energy challenges faced by rural farmers.

The economic and environmental advantages of harnessing solar power for post-harvest processing are well-documented. A study by Mohammadi et al. (2020) reveals that the adoption of solar energy reduces operational costs for farmers, making it a financially viable option. Additionally, the environmental sustainability of solar power aligns with global efforts towards reducing carbon emissions and mitigating climate change (IEA, 2022).

While the benefits of solar power adoption in agriculture are evident, challenges persist. The literature underscores the initial investment as a significant hurdle (Adekunle & Muhammed, 2021).

II. MATERIALS AND METHODS

SOSAI conducted a baseline assessment involving a total of 320 farmers, 96 kiosks, and 76 millers across 30 communities in 11 Local Government Areas (Sanga, Kudan, Kagarko, Jaba, Sabon-Gari, Lere, Ikara, Kauru, Giwa, Makarfi, and Igabi) of Kaduna state. The mixed survey method was adopted where

both quantitative and qualitative questions were administered to respondents. Respondents were sampled using a mix of purposive and convenience sampling across the communities. Interviews were conducted in a face-to-face manner and survey questions were administered to respondents via the use of mobile data collection.



Figure 1: A map of Kaduna state with various locations data was collected (September 2023).

Key findings from the baseline

Farmers

71% (n=208) of farmers prefer to process their produce before sales or consumption, but only 35% (n=112) process their produce post-harvest before sales or consumption primarily due to the limited access to efficient processing machines, increased cost, and proximity (Figure 2).

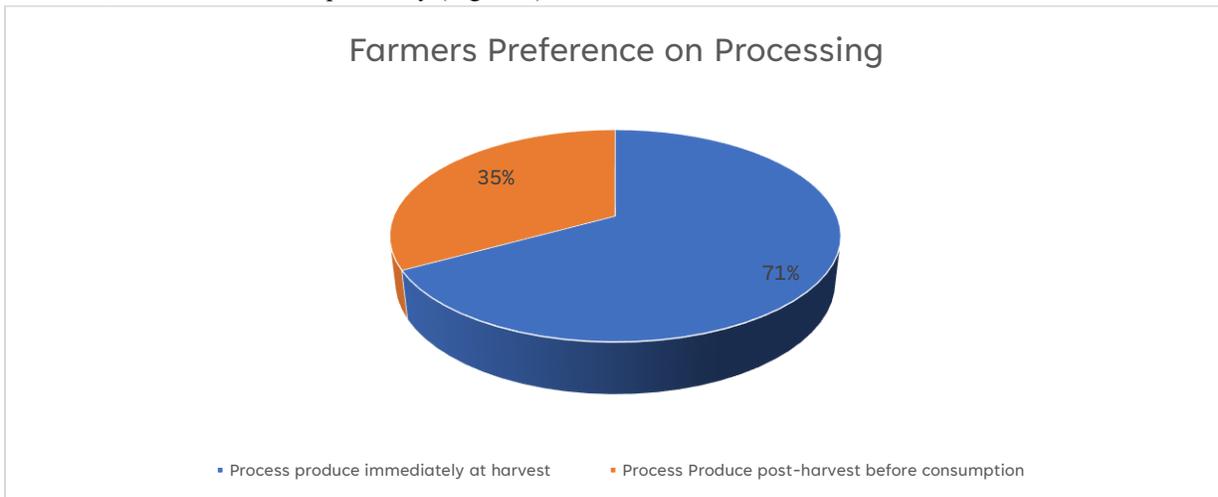


Figure 2: Distribution of Farmers Based on Their Preference on When to Process Produce Before Consumption or Sale (Field survey, 2023)

Millers

78% (n=59) of millers use diesel-powered milling machines, 16% (n=12) (electric-powered), and 6% (n=5) (petrol-powered) mills (Figure 3). Millers purchase fuel within their locality mostly (52%, n=39), while others travel between 1 to 10km to buy fuel. The price per litre of diesel is 1,250 and 250NGN for

fuel. Millers who use petrol spend an average of 11,140NGN weekly to mill about 2,045kg of grains. All millers indicated strong interest in accessing a solar mill which means reduced cost hence reducing fees charged to farmers to process produce. The cost of fuel is the main driver for being interested in solar-powered mills.

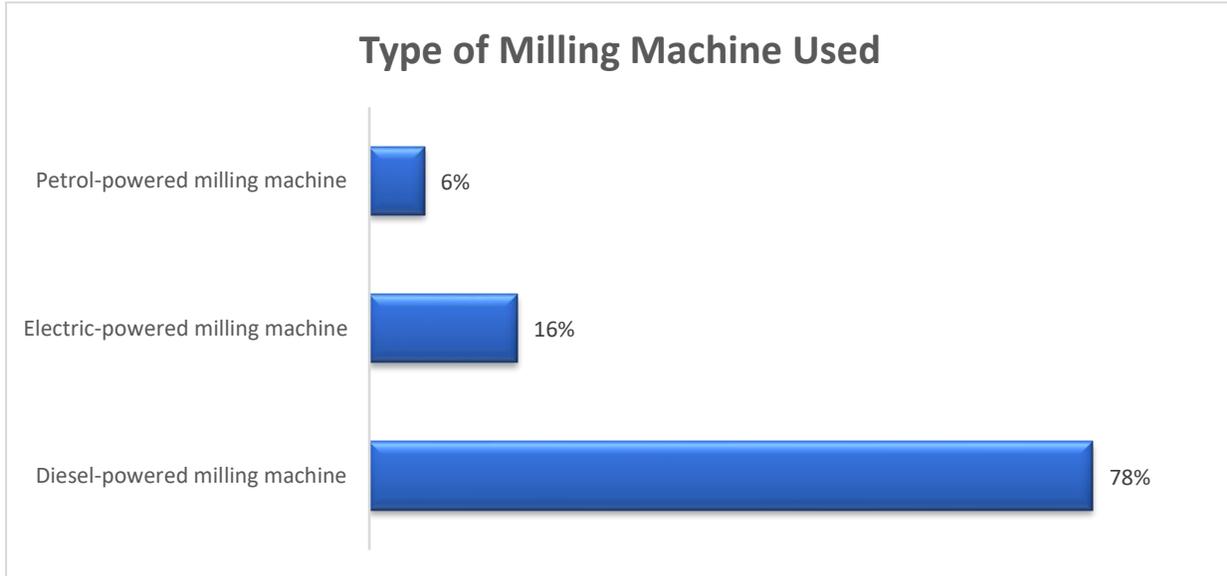


Figure 3: Categories of Milling Machines Commonly Used (Field survey 2023)

Kiosk

Kiosk owners within the study locations primarily sell packaged food and drinks (72%, n=69), 18% (n=17) (fresh food), and 10% (n=9) (meat, fish, solar lights) (Figure 4). Solar products they are interested in are refrigerators (31%, n=30), fans (33%, n=31), ice

freezer (20%, n=19), television (12%, n=12), and solar cookers (4%, n=4) (Figure 5). This indicates the potential impact solar facilities such as solar-powered refrigerators, freezers, and cookers have on the target beneficiaries in rural communities within Northern Nigeria.

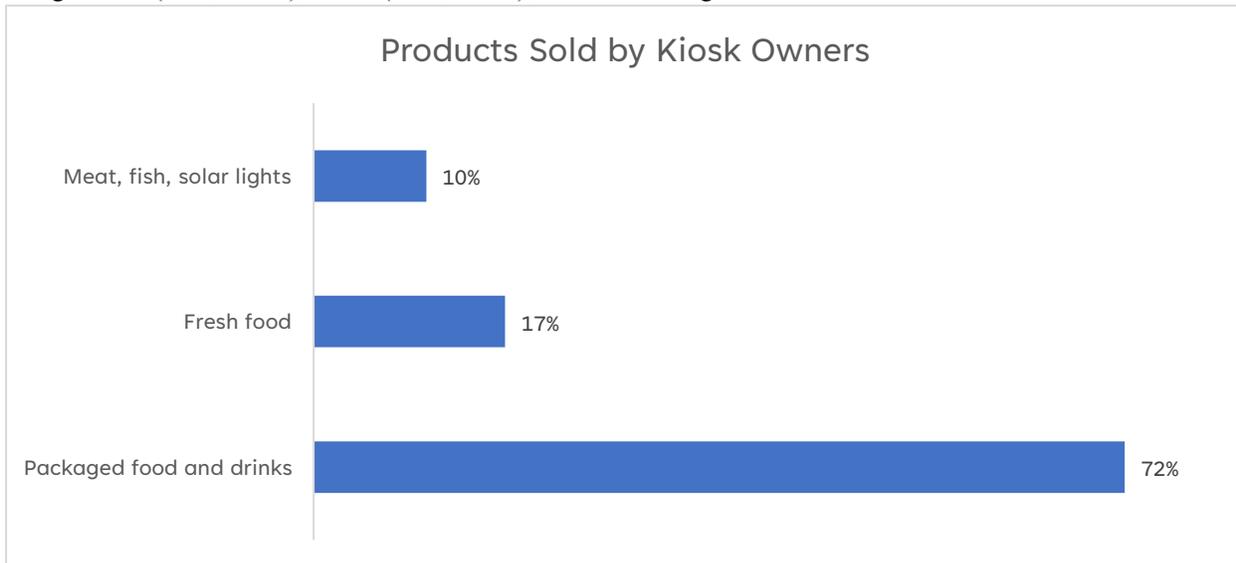


Figure 4: Products Predominantly Sold by Kiosk Owners (Field Survey, 2023)

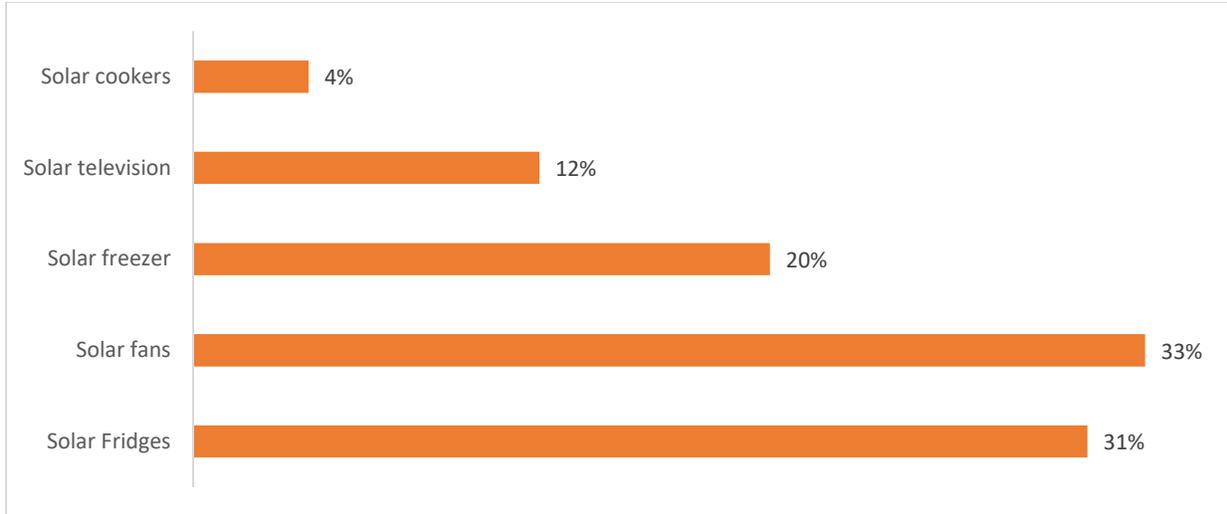


Figure 5: Categories of Solar Products Respondents Desire to Own (Field Survey, 2023)

III. EVIDENCE DOCUMENTED

SOSAI Renewable Energy, through the Agridi-funded project, has undertaken a transformative initiative in Kaduna state. This project stems from a comprehensive baseline assessment that identified a demand for renewable energy solutions and support for female agro-processors in the region. The key technology that has enhanced the success of the project is termed – Market Map.

Innovative Technology - Market Map:

Central to the success of this initiative is the implementation of an innovative technology called "Market Map." This technology serves as a platform to connect and empower agro-processors, fostering collaboration, and providing crucial insights into market dynamics.

IV. KEY ACHIEVEMENTS

Empowering Female Agro-Processors

SOSAI Renewable Energy has successfully onboarded 41 female agro-processors in Kaduna state under this initiative. These agro-processors have gained access to credit facilities up to the tune of over ₦5,000,000.00, enabling them to invest in their businesses and scale up their operations.

Solar-Powered Infrastructure

The project has provided solar-powered dryers and machines to the agro-processors. This renewable energy solution has not only reduced operational costs

by over 40% but also enhanced the sustainability of their processing activities.

Cost Reduction and Increased Productivity

As a result of the solar-powered infrastructure and innovative technology, the costs of processing have seen a significant reduction, estimated at around 50%. This cost efficiency has allowed agro-processors to allocate resources more effectively, contributing to increased productivity and profitability.

Rural Household Empowerment

The initiative has empowered many rural households (over 1,250 households) to engage in agro-processing activities. With reduced processing costs and improved access to markets, these households are now able to add value to their produce and enhance the shelf-life of their agricultural goods.

Diversification of Income Streams

Female agro-processors are now involved in the business of drying various vegetables and locally grown produce. This diversification has not only created multiple income streams for the processors but has also added value to the local agricultural supply chain.

Socio-Economic Impact

The project has brought about positive changes in the economic landscape of Kaduna state, particularly in rural areas, by empowering women in agro-processing and creating sustainable business models.

V. OUTLOOK

SOSAI Renewable Energy remains committed to the continuous improvement of the AgriDi-funded project. The goal is to expand its impact, reaching more agro-processors, enhancing technological solutions, and contributing to the overall development of the agricultural sector in Kaduna state. The success of this initiative highlights the potential of innovative technology and renewable energy to drive positive change and empower communities in the agro-allied sector.

VI. ACKNOWLEDGEMENT

The authors wish to appreciate the AgriDi project for the support provided to implement the Market Map Project in Kaduna state.

VII. CONFLICT OF INTEREST

There is no conflict of interest.

REFERENCES

- [1] Adedeji I, Deveci G, Salman H, Abiola I. The Benefits of Solar Energy on the Provision of Sustainable Affordable Housing in Nigeria. *J of Power and Energy Eng* 2023; 11:1-15. doi: 10.4236/jpee.2023.116001.
- [2] Adekunle AS, Muhammed O. "Assessment of Solar Drying Technologies for Agricultural Products in Northern Nigeria." *J of Ren Energy* 2021; 3:23-31.
- [3] International Renewable Energy Agency (IRENA). "Renewable Energy Market Analysis: Nigeria." 2022.
- [4] Kaduna State Ministry of Agriculture. "Agricultural Sector Report: Challenges and Opportunities in Post-Harvest Processing." 2022.
- [5] Koirala BP, Hakvoort RA, Van Oost EC, Van der Windt HJ. Community energy storage: Governance and business models. In *Consumer, prosumer, prosumager: How service innovations will disrupt the utility business model*, ed. F. Sioshansi. London: Academic Press. 2019; p209–234.
- [6] Mohammadi Z, Mirdamadi SM, Farajollah HSJ, Lashgarara F. Qualitative analysis of effective

factors on the feasibility of utilizing solar technology in the poultry industry. *Int J of Env Sci and Tech*, 2020; Vol.:(0123456789), <https://doi.org/10.1007/s13762-020-02870-2>.

- [7] Olayide OE, Heidhues F. "Agricultural Transformation in Nigeria: Trends, Policies, and Implications for Sustainable Development." *The Eur J of Dev Res* 2020; 32(2):245-273.
- [8] United Nations Development Programme (UNDP). "Sustainable Development Goals Report: Nigeria." 2022.
- [9] World Bank. "Nigeria - Solar Power for Agriculture: A Pathway to Sustainable Development." 2022.