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Productivity of Melon Shelling Technology and Preference by Rural Women in Nigeria

Oyediran Wasiu Oyeleke
Department of Agricultural Extension and Rural Development, Federal University of Agriculture Abeokuta, Nigeria
Email: oyediran_wasiu@yahoo.com

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Abstract

Few years ago National Centre for Agricultural Mechanization (NCAM) launched melon sheller to reduce burden of obtaining melon oil and cake, and to enhance rural women's productivity. This study looked at the productivity of promoted melon shelling technology and preference by rural women in Nigeria. Data were gathered from the NCAM workshop and survey of melon processors in Niger State. In the workshop, it was found that time allowed for soaking melon and covering with piece of clothes contributed to the productivity of the sheller. Results from survey revealed that 95.1% of the respondents' preferred Internal Combustion technology and 90.2% liked electric-driven melon shellers over the manual one. Also, 69.5% obtained the shellers from local fabricators rather than NCAM. The technology led to increased turnout of melon (378kg/hr) and reduced wastages to 1.26kg out of 75.6kg. The study concluded that the promoted melon sheller is efficient and have positive implication on the rural women's productivity and revenue. The study recommends that the rural women should put the melon sheller into its maximum capacity use. The NCAM should extend training to the local fabricators so that they can improve on the technology most especially in the areas of winnowing and washing of melon kernels.

Keywords: Effectiveness; Drudgery; Melon; Shelling technology; Rural women; Revenue; Nigeria.

1. Introduction

Since the 1970s the academic community has been studying and documenting evidence of the neglected role of women in agricultural development [1]. In developing countries, women are often categorized as the poorest of the poor and economically bankrupt [2, 3]. The major contributing factor to this dilemma is poor handling and processing of agricultural produce due to rudimentary technology which has resulted to economic losses for the rural women [4]. The last twenty years have however witnessed great investment in agricultural research and development of new technologies in Nigeria. The national and international research centers have reported significant improvement in many agricultural sectors. Small scale agro-processing technologies have been launched in some research institutes. It has been a primary factor contributing to increases in farm productivity in the country. Although there is still widespread food insecurity particularly due to Boko-Haram insurgence, banditry and of recent COVID-19 pandemic, the situation without current technology development would have been unimaginable. Efforts are being geared towards the replacement of human operator with mechanical systems including automated ones as human operations are inconsistent and less efficient. There is ample evidence that the contribution of internally generated improved technology in Nigeria's agricultural sector is substantial. Generally, in an effort to reduce human drudgery, minimize labour costs and enhance overall productivity and efficiency, the national research institutes have designed, fabricated and tested an array of improved melon processing technologies suitable for use under Nigeria's socio-economic environment and conditions. Examples of such technologies include melon depodder, washer, sheller, oil extractor and impulse sealer. Prior to the sheller innovation, shelling and processing of melon have always been through hand shelling by the rural women [5]. These techniques cannot substantially minimize drudgery, seed spoilage and losses, which consequently affect quantity and quality of melon oil supply in the market [6].

On this premise, this study estimated the output of the promoted technology (melon sheller) inside the workshop and on the field, identified various sources and preference of improved sheller, and evaluated how the rural women find it useful.

2. Research Methodology

This study combined experimental and survey to get data. Experiment was carried out in the NCAM workshop while the survey was on melon processors. Performance of the technology was measured as the actual output versus input in kilogram (kg) multiply by 100.

2.1. Experimental Design

Most of the previous studies carried out by engineers were concentrated on how quantity of water added to melon seeds affects efficiency of sheller in terms of percentage of shelled melon versus unshelled seeds and broken seeds. This study however looks into how length (hours) of soaking melon could affect rate of shelling melon and percentage of wastages. The design of this experiment was based on indigenous knowledge of soaking melon in very little water overnight either in a calabash or jute bag and of recent in a bowl by the rural women.

4.8kg of melon (equivalent to 6 local congos) were purchased at rate of ₦150.00/congo from Amoyo market, Ilorin and the seeds were taken to NCAM workshop. The seeds were divided into 3 equal portions (i.e. 1.6kg each) and transferred to bowls labeled A, B and C. Equal quantity of water (150cl) were added to each replicate, the melon were thoroughly turned and the water were later drained to ensure that the melon are soaked under similar moisture content regime. Replicate A and B were left opened while replicate C was covered with a piece of cloth to serve as control. The experiment was carried out daily between hours of 9.00 a.m. – 5.20 p.m. for six weeks. The same procedures are repeated for each replicate twice in a week and average data taken.

Descriptive statistics like frequency, percentages, mean and standard error was used for the data collected.

3. Results and Discussion

3.1. Part A: Workshop Data

3.1.1. Findings from the Application of Melon Sheller in the Workshop

3.1.1.1. Replicate A1

At exactly 30minutes timing, the melon in replicate A1 was transferred into the sheller through the hopper and collected via the outlet. The output was dried and subsequently sieved to separate shelled kernels from unshelled ones. Each component was weighed and records were taken. The quantity of shelled seeds was very high compare to unshelled seeds (2.93:1) but there were too much broken kernels (0.40kg). The percentage of shelled melon was 73.3%. Overall, the average melon shelled was 1.26kg.

3.1.1.2. Replicate B1

Melon seeds in replicate B1 was put in the same sheller at exactly 2hours timing of soaking. The same procedures as in step 1 were followed. The quantity of shelled seeds was relatively higher (1.25kg) in replicate B1 than the output obtained from replicate A1 (1.17kg). The percentage of shelled melon increased to 78.10%.

3.1.1.3. Replicate C1

The melon in replicate C1 was left for 5hrs before it was transferred into the melon sheller. Similar procedures taken in step 1 and 2 were followed. However, the quantity of shelled seeds was considerably the highest compare to those obtained in replicate A1 and B2. The percentage of shelled melon was 85.6%.

Table-1. First week productivity

Replicate 1	Moisture content (cl.)	Qty. of seed (kg)	Time (hrs.)	Shelled (kg)	Unshelled (kg)	Percentage shelled (%)	Proportion (shelled vs. unshelled)
A1	150	1.60	0.50	1.17	0.40	73.30	2.93:1
B1	150	1.60	2.00	1.25	0.33	78.10	3.79:1
C1	150	1.60	5.00	1.37	0.21	85.60	6.52:1
Mean	150	1.60	2.50	1.26	0.31	79.00	4.41:1
Std. Error	0.00	0.00	0.56	0.03	0.02	1.52	0.46:0

Source: Researcher's experimental results at NCAM workshop, 2016

The productivity of the replicate A2, B2 and C2 in Table 2 are 71.9%, 77.5% and 86.3% respectively. There is a marginal increase in the productivity of C2 than C1 by 0.7%. Proportion of shelled melon is seven times of the unshelled in replicate C2. But, on the average melon shelled in replicate 2 was 1.26kg which is similar to the first week output in replicate 1.

Also, replicate A3, B3, C3 in Table 3 have productivity of 73.8%, 76.3% and 84.4% respectively. The quantity of shelled though increase from 1.18kg in A3 to 1.35kg in C3 the marginal productivity of C3 drops to that of C2 by 1.9%, that is, unshelled and broken melon were higher in C3 than C2. Overall, the average melon shelled in replicate 3 was 1.25kg; this is lesser to the quantity of output obtained in replicates 1 and 2 by 10g.

Table-2. Second Week productivity

Replicate 2	Moisture content (cl.)	Qty. of seed (kg)	Time (hrs.)	Shelled (kg)	Unshelled (kg)	Percentage shelled (%)	Proportion (shelled vs. unshelled)
A2	150	1.60	0.50	1.15	0.41	71.90	2.81:1
B2	150	1.60	2.00	1.24	0.35	77.50	3.54:1
C2	150	1.60	5.00	1.38	0.19	86.30	7.26:1
Mean	150	1.60	2.50	1.26	0.32	78.57	4.54:1
Std. Error	0.00	0.00	0.56	0.03	0.03	1.79	0.59:0

Source: Researcher's experimental results at NCAM workshop, 2016

Table-3. Third Week productivity

Replicate 3	Moisture content (cl.)	Qty. of seed (kg)	Time (hrs.)	Shelled (kg)	Unshelled (kg)	Percentage shelled (%)	Proportion (shelled vs. unshelled)
A3	150	1.60	0.50	1.18	0.41	73.80	2.88:1
B3	150	1.60	2.00	1.22	0.35	76.30	3.49:1
C3	150	1.60	5.00	1.35	0.24	84.40	5.63:1
Mean	150	1.60	2.50	1.25	0.33	78.17	4.03:1
Std. Error	0.00	0.00	0.57	0.02	0.02	1.36	0.35:0

Source: Researcher's experimental results at NCAM workshop, 2016

In Table 4, C4 replicate has the highest productivity of 87.5%, followed by B4 79.4% and A4 has 70.6%. The shelled melon is 8 times higher than the unshelled melon seeds in replicate C4. The more the time interval allowed for the moisture absorption the higher the productivity of the sheller. Overall, the average melon shelled in replicate 4 was 1.27kg; this is greater than output obtained in replicates 1, 2 and 3.

The output in replicate C5 followed the similar trend of C1, C2, C3 and C4 with highest productivity of 86.3% in C5 and the least of 70.6% in A5. The proportion of shelled versus unshelled melon is however lower in C5 than C4. The average melon shelled in replicates 5 and 4 are the same, that is, 1.27kg. More so, C6 recorded highest productivity (86.2%) compared to B6 (75.6) and A6 (71.3%). There is 0.1% marginal difference in the productivity of C5 and C6. Yet, the average melon shelled in replicate 6 was 1.24kg.

Table-4. Fourth week productivity

Replicate 4	Moisture content (cl.)	Qty. of seed (kg)	Time (hrs.)	Shelled (kg)	Unshelled (kg)	Percentage shelled (%)	Proportion (shelled vs. unshelled)
A4	150	1.60	0.50	1.13	0.34	70.60	3.32:1
B4	150	1.60	2.00	1.27	0.30	79.40	4.23:1
C4	150	1.60	5.00	1.40	0.17	87.50	8.24:1
Mean	150	1.60	2.50	1.27	0.27	79.17	5.26:1
Std. Error	0.00	0.00	0.56	0.03	0.02	2.08	0.64:0

Source: Researcher's experimental results at NCAM workshop, 2016

Table-5. Fifth Week productivity

Replicate 5	Moisture content (cl.)	Qty. of seed (kg)	Time (hrs.)	Shelled (kg)	Unshelled (kg)	Percentage shelled (%)	Proportion (shelled vs. unshelled)
A5	150	1.60	0.50	1.13	0.42	70.60	2.69:1
B5	150	1.60	2.00	1.24	0.35	77.50	3.54:1
C5	150	1.60	5.00	1.38	0.20	86.30	6.90:1
Mean	150	1.60	2.50	1.27	0.27	79.17	5.26:1
Std. Error	0.00	0.00	0.56	0.03	0.02	2.08	0.64:0

Source: Researcher's experimental results at NCAM workshop, 2016

Table-6. Sixth Week Productivity

Replicate 6	Moisture content (cl.)	Qty. of seed (kg)	Time (hrs.)	Shelled (kg)	Unshelled (kg)	Percentage shelled (%)	Proportion (shelled vs. unshelled)
A6	150	1.60	0.50	1.14	0.45	71.30	2.53:1
B6	150	1.60	2.00	1.21	0.35	75.60	3.46:1
C6	150	1.60	5.00	1.38	0.18	86.20	7.67:1
Mean	150	1.60	2.56	1.24	0.33	77.70	4.55:1
Std. Error	0.00	0.00	0.56	0.03	0.03	1.89	0.67:0

Source: Researcher's experimental results at NCAM workshop, 2016

3.2. Part B: Field Survey Data

3.2.1. Findings from the Field Application of Improved Melon Sheller by the Melon Processors

In Table 7, all the respondents (100.0%) indicate that the technology led to increased turnout of melon kernel about 1,260 – 3,150kg/day as against 2.52 – 3.78kg/day before the advent of technology. This was confirmed through observation of the sheller and weighing of the melon output on the field. Also, 62.6% of the respondents reported that proportion of wastages has reduced from 8.82:75.6kg to 1.26:75.6kg. In contrast, majority (71.7%) of the respondents complain that the melon output obtained from improved melon technology is not clean and that the women are still using conventional method to wash, dry, and winnow the kernel. The implication is that conventional method of cleaning reduces effective utilization of sheller technology and affects production output of the women as they move from one operation to the other. Meanwhile, 70% of the respondents reported that the technology saves time of shelling, that is, it had time efficiency of approximately 378kg/hr (300 *mudus* per hour). Even with this rate of production the improved melon sheller has not been fully utilized to its recommended capacity of 800kg/hr (635 *mudus* per hour). Field and John [7], opined that simple agricultural technology is an innovative that resulted in higher food production to cater for population explosion especially in sub-Saharan Africa.

Table-7. Field application of improved melon sheller

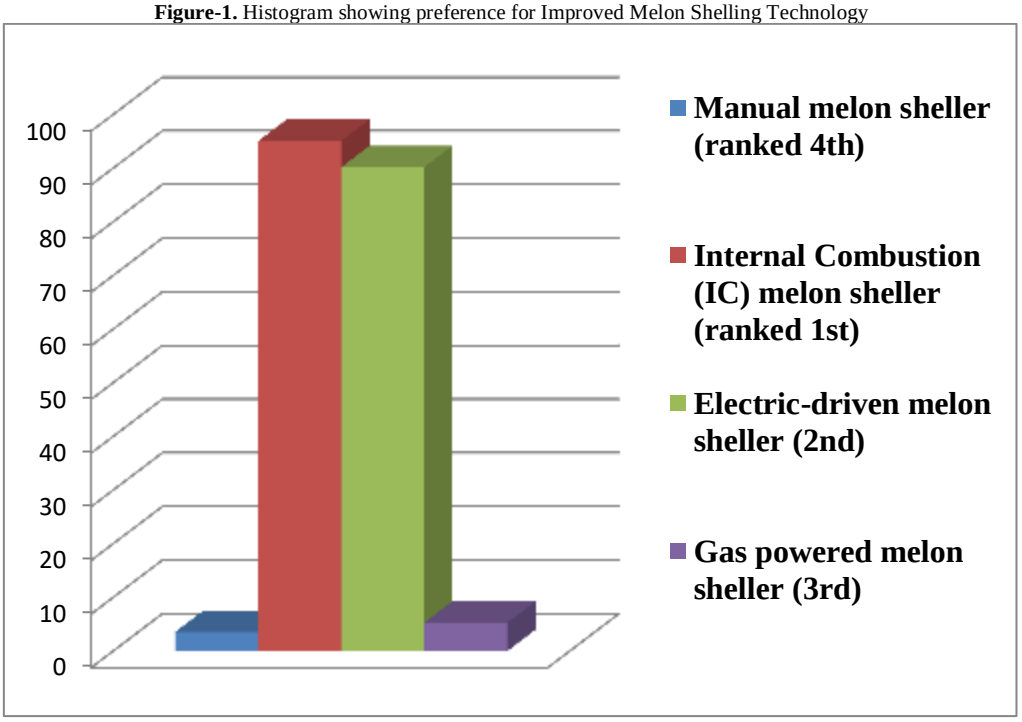
Usefulness of the melon sheller	Yes %	No %	Quantity (kg)	Ratio (kg)
Increased turnout of melon kernel	100.0	0.0	1,260 – 3,150	
Reduced wastages to melon kernel	62.6	37.4		1.26:75.6
Clean output/quality output is obtained	28.3	71.7		
Saved time of processing melon	70.9	29.1		378/hr.
Reduced drudgery in melon processing	28.3	71.7		

Source: Field Survey, 2017. Multiple responses recorded. 1 bag = 50kg.
1 *mudu* of shelled melon approximately weighed 1.26kg

3.3. Melon Processors' Preference for the Improved Melon Shelling Technology

The result in Figure 1 indicates that internal combustion (IC) melon sheller (95.1%) and electric-driven melon sheller (90.2%) were ranked first and second respectively as the most preferred technology by the respondents. Field observations have shown that internal combustion melon sheller speed faster and its efficiency (1,890kg/day) is higher than electric-driven melon sheller (1,260kg/day), that is, 30:20 outputs of bags per day; also, it does not depend on electricity supply which may not be available when it is actually needed by the melon processors. Gas powered melon sheller was ranked third. It has highest efficiency of approximately 3,150kg/day (50 – 60 bags/day) as reported by the respondents (those using it) but it was newly introduced and not very common in the study area. The least ranked was the manual winding sheller. According to the respondents, manual winding sheller is inefficient and requires a lot of manpower to run it with little output of 50.4kg/day (less than 1 bag/day) and as such it is no longer in vogue since advent of IC and electric-driven melon shellers a decade ago by the NCAM, and of recent gas-powered sheller. Asoegwu and Asoegwu [8], have reported that manual sheller is grossly inefficient as it relied on manpower of about 0.10hp.

Figure-1. Histogram showing preference for Improved Melon Shelling Technology



Source: Field Survey, 2017

Plate-1. Internal Combustion (IC) that

Plate-2. Motorized melon sheller that uses uses petrol at (NCAM, Ilorin). electricity (ECE) at Lapai, Niger State

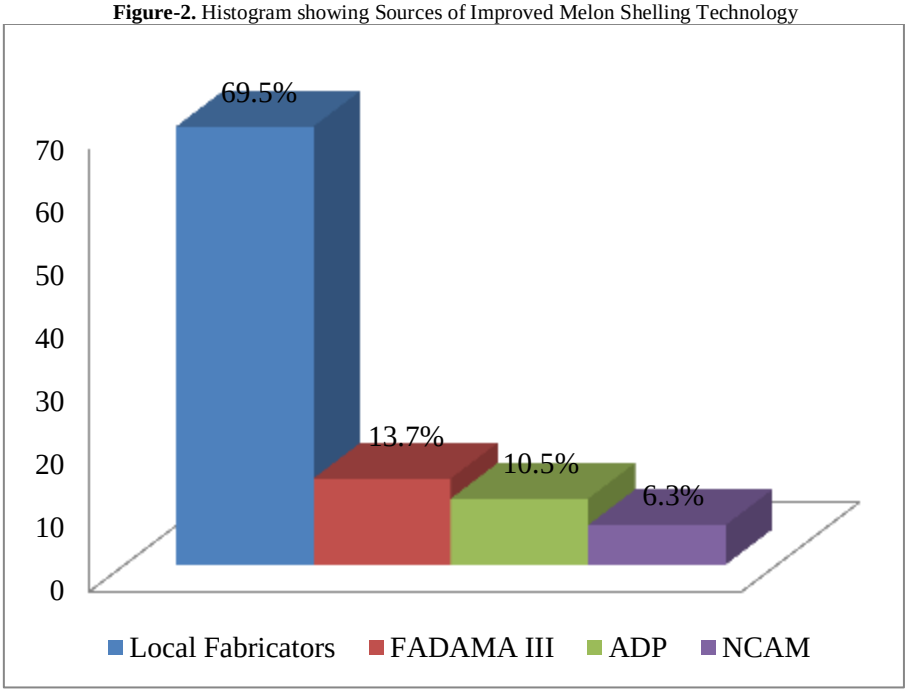
Plate-3. Melon sheller that uses gas at Maijahidu village, Niger State

Plate-4. Manual melon sheller (NCAM Ilorin)

3.4. Sources of Improved Melon Shelling Technology

Result in Figure 2 shows that majority (69.5%) of the respondents obtained the sheller from local fabricators, while 13.7% got it from FADAMA III, 10.5% acquired it through Agricultural Development Programme ADP, and 6.3% purchased it from NCAM. The reason why the shellers are sourced locally may be attributed to the fact that the Local Fabricators are very closer to the rural women and they assist in fixing faults that arise on the sheller.

Figure-2. Histogram showing Sources of Improved Melon Shelling Technology



Source: Field Survey, 2017

3.5. Extension Service Support and Women's Credit Facility for the sheller

Result in Table 8 shows that 22.9% of the respondents had contact with extension agents every month, 48.9 percent had contact with extension agents about 2 - 3 years ago and 28.2 percent did not have contact with extension agents in the past 4 years. The result on extension visits showed that most of the rural women had limited contact with extension agents/officers. Extension visits would have a positive effect on melon processors' ability to respond to new innovations and techniques as well as to latest technologies on melon processing in the study area. Women have less access to extension services and vocational training, credits and technologies [9]. Access to extension and education has a major impact on rural women's potential in income-generating opportunities. When rural women are economically empowered, their children are less likely to engage in child labour [10].

Furthermore, 67.1% used personal savings as financial assets, while 26.8 percent borrowed from thrift and cooperative societies and 6.1% got financial support from friends and family. According to Onwurafor and Enwelu

[11] majority of rural women use personal funding instead of bank credits for agro-processing, and this has limited expansion and growth of their enterprise. The implication of this finding is that by belonging to a cooperative society, melon processors have opened up avenue for effective mobilization of financial and human resources needed for sheller acquisition and effective melon processing. Alliance [12] affirmed that cooperatives offer social and cultural platforms through which members assume mutual ownership of risks arising from business and daily living.

Table-8. Extension visit and available capital

Extension contact	**Frequency**	**Percentages**
Monthly	87	22.9
2 – 3 years	186	48.9
More than 4 years	107	28.2
Credit Facility		
Personal savings	255	67.1
Friends & family	23	6.1
Thrift & Cooperative societies	102	26.8

Source: Field Survey, 2017.

4. Conclusion

The study found that variation in the time allowed for water absorption and other conditioning like covering with cloth or tarpaulin influenced the performance of the sheller. The more the time allowed the more tender the melon becomes; hence it is easier to shell the melon with resultant higher productivity. The outcome of this experiment is in line with prevailing practice found on the field among the melon processors. So, the rural women by their indigenous experience have incorporated the practice to the improved shelling method and over the time there has been continuous improvement on it and increasing output and economic returns are realized. It was established that melon processors preferred internal combustion (IC) melon sheller as it led to increased turnout of melon, reduction in wastages and saved time of operation. Meanwhile, the output obtained from the improved technology is not cleaned which necessitate manual winnowing and washing of the shelled melon by the rural women.

The study suggests that the melon sheller should be improved upon by NCAM and Agricultural Engineers to address the problems of unclean output and drudgery passing through by the melon processors. Since the local fabricators are closer to the melon processors at the grass root, regular training should be organized by NCAM to equip the local fabricators and improve their expertise to be able to fix some complex faults in the shellers.

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