PROFITABILITY ANALYSIS OF MAIZE FARMERS USING MODERN FABRICATED SOLAR DRYER IN ODEDA LGA OF OGUN STATE, NIGERIA

Oni, E.O.[1]
Fapojuwo, O.E.[2]
Kareem, I.A.[3]
Badmos, A.O.[4]
Adeleye, T.M.[5]
Oluwafemi, F.[6]

[1,2,3,4,5,6]Federal University of Agriculture, Abeokuta, Nigeria

*Corresponding Email: onieo@funaab.edu.ng

Citation: Oni, E.O., Fapojuwo, O.E., Kareem, I.A., Badmos, A.O., Adeleye, T.M. & Oluwafemi, F. (2022). Profitability analysis of maize farmers using modern fabricated solar dryer in Odeda LGA of Ogun state, Nigeria. *KIU Interdisciplinary Journal of Humanities and Social Sciences, 3*(1), 284-294

ABSTRACT

In Nigeria, well over 30% of maize produced yearly is lost in storage due to improper drying methods and postharvest practices by rural farmers. Also, income of rural farmers over the years have been a great concern to the economy. This study analyzed the profitability of maize farmers in Odeda local government area with the use of modern fabricated solar dryer (MFSD). A total of 105 randomly sampled maize farmers from two villages in the local government were interviewed using semi-structured questionnaire. Descriptive statistics was used to analyze the socioeconomic characteristics of the respondents and their drying methods while budgetary analysis was used to estimate the profitability of maize. Results showed that majority of the farmers were young-males, with no formal education and had above 30 years of experience in maize farming. The major problems identified amongst the farmers was lack of credit facilities, lack of working capital (assets like land) and lack of skills (education). The result of profitability analysis of maize from the two major farms after the use of the fabricated dryer revealed a profit margin of 100%. Recommendation for this study is that farmers should be encouraged to invest more and increase their input in agriculture so as to improve their output by the use of modern dryer. Also, the government should give concessions to the rural farmers in various aspects which include provision of credit facilities and infrastructures. The use of the MFSD drying method by rural maize farmers reduced post-harvest losses by 65% irrespective of variety, and significantly boosted the farmer's profit margin.

Keywords: Profit margin, Revenue, Rural farmers, Maize, Drying

INTRODUCTION

Agriculture in Nigeria is dominated by small-scale farmers who are engaged in the production of the bulk of food requirements of the country (Oladebo, 2004; Girei et al., 2018). Smallholder farmers are regarded as people with landholdings of less than 10 hectares. They make up about 80% of Nigeria's farming population and are responsible for 80% – 90% of food production in Nigeria but they are the poorest groups in the country (Mgbenka and Mbah, 2016). These smallholder farmers though individually look insignificant but collectively form an important foundation upon which the Nigerian Agriculture rests (Ibitola et al., 2019). High attention is now been paid to rural farmers income by some scholars (Corral and Reardon, 2001)

Maize (Zea mays L.) is from the family Poaceae and is an annual cereal crop that is consumed and cultivated globally (Tajamul et al., 2016). Maize is a staple crop for billions across the globe including Afica, Latin America and Asia (Yaouba et al., 2012; FAOSTAT 2018). It has a variety of uses, it provides food for humans and animals and equally useful in industrial application as raw materials (FAO, 2017) and is referred to as the cereal of the future because of its nutritional value and utilization of its products and by-products (Suleiman et. al., 2013). The demand for maize has been estimated to increase by 50%, from 558 million metric tons in 1995 to 837 million metric tons in 2020 (Martinez et al., 2011).

Maize grains are high value crop which can be colonized by fungi under favorable conditions thus leading to food spoilage by aflatoxins (Alshannaq and Yu, 2017). Aflatoxins are produced by fungi belonging to Aspergillus section Flavi (Frisvad et al., 2019). They are highly toxic and carcinogenic compounds that negatively impact the health of both humans and livestock (Bryden 2012; Alshannaq and Yu, 2017). Fungal growth in maize is facilitated by hot and humid conditions (Egal et al., 2005) resulting in color change, decrease in nutritional values, and reduction of overall quality and quantity of the maize (Alshannaq and Yu, 2017). Inability to dry agricultural produce to safe moisture level is the primary cause of post-harvest loss and toxicity. In addition, lack of appropriate preservation, storage systems and mycotoxin contaminations also cause considerable losses, thus reducing the food supply significantly (Warburton and Williams, 2014).

Akhtaruzzaman et. al., (2017) posited that sun drying (natural air drying) is the most common form of drying in many countries, particularly where the open-air temperature reaches 30 °C or higher. Natural air drying is a method used to dry maize by passing unheated (natural) air through the grain mass until its moisture content reaches

equilibrium moisture content (EMC). Sun drying, a traditional and old method of drying grain on mud or concrete floors is an inexpensive, easily manageable and the most widespread method of food preservation in African countries due to solar irradiance being very high and abundant all through the year (Ullah et. al., 2010). However, there are drawbacks relating to the traditional method of drying, including unfavorable weather conditions during harvesting and drying period leading to microbial proliferation, non-uniform drying leading to crop deterioration, insect infestation, contamination, attack by birds and domestic animals, poorer quality of food, labour and time intensive system (Oyekale et al., 2012; Akhtaruzzaman et. al., 2017).

Proper drying of grain is necessary to reduce the growth of aflatoxigenic fungi and toxins development (Bradford et al., 2018). Furthermore, serious drying problems occur especially in humid tropical regions where some crops have to be dried during the rainy season. Hence, to boost food security and availability of high-quality marketable products in the country, the provision of an efficient drying method to reduce or eliminate post-harvest losses of agricultural produce, especially due to microbial contamination and degradation, is of importance.

Therefore, to reduce the losses associated with traditional method of drying maize, this study analyzed the profit margin of the maize farmers before and after the use of the modern fabricated solar dryer.

METHODS

The study was carried out at the Federal University of Agriculture Abeokuta, Nigeria and Odeda Local government area in Ogun State, Nigeria. Simple random sampling technique was used to select 105 farmers from two purposively selected villages (Baba pupa and Mogan) in the local government due to high production of maize. An interview schedule was used to collect data from the respondents and data were analyzed using descriptive statistics and budgetary analysis. Two varieties of freshly harvested maize samples P4063W and P4226 were collected from the two villages and (hybrid) variety P3966W was collected from Federal University of Agriculture (FUNAAB) Farm. Samples were collected at two (dry and wet) seasons of the year and on-site participatory approach was used to carry out trial experiment on the farms. Three packaging materials (plastic container, jute and polythene bag) were locally purchased at Adatan market Abeokuta and sterilized with (10%) sodium hypochloride solution prior to usage. Modern solar dryer was fabricated using 24 volts 80 watts solar panels, 200AH solar deep cycle batteries, 20 Amp solar charger controllers, energy saving fan and heater.

Descriptive statistics: this involved the use of frequency, percentages and tables to describe the socioeconomic characteristics of maize farmers in the study area.

Budgetary Analysis: was used to determine the profit to maize production in the study area.

$\pi = TR - TC$ ---------- Eq. 1

Where π = Profit (N)

TR = Total Revenue (N) given as Py.Y ---------- Eq. 2

Where Py = price/unit of maize

Y = maize output (kg)

Total cost (TC) = TFC + TVC ---------- Eq. 3

Where;

TFC = Total fixed cost

TVC = Total variable cost

Gross Profit (GP) = TR – TVC ---------- Eq.4

Net Profit (NP) = GP – TFC ---------- Eq. 5

RESULTS

Table 1: Socioeconomic Characteristics of Maize Farmers

Varieties	Category	Frequency	Percentage (%)
Age (Years)			
15-40	Young Workers	87	82.86
41 above	Elderly Workers	18	17.14
Gender	Male	93	88.57
	Female	12	11.43
Education	Tertiary Education	10	9.5
	Sec. Education	21	20
	Pry Education	44	41.9
	No formal Education	30	57
Farming Experience	1-10	6	5.71
(years)	11-20	21	20.00
	21-30	17	16.19
	31 and Above	61	58.10

Major sources of finance	Personal Savings		94	89.5
	LG/State Loan		2	1.9
	Cooperative Loan		6	5.7
	Bank	Loan	-	-
	Inheritance		3	2.86
Farm Size (Ha)	<1 hectares		53	50.48
	2-5 hectares		37	35.24
	> 5 hectares		15	14.29
Storage Time of maize	>1 year		102	97.14
Above	2years		3	2.86
Drying methods used	Open air drying		94	89.5
	Others		11	10.48
Storage methods	Barns		61	58.10
Used for grains	Jute bag		21	20.0
	others		17	16.19

Table 2: Farmers' revenue before and after the use of the modern fabricated solar drying method

Questions	**Baba Pupa village Farm 1**	**Mogan village Farm 2**
Total revenue from farming activities/annum	756,330	1,401,225
Traditional drying used before the solar dryer	Open air drying	Open air drying
Maize quantity stored before the use of solar dryer and the unit price (kg/N)	5000/220	12,000/220
Maize quantity stored after the use of solar dryer and the unit price (kg/N)	10,200/ 220	20,000/220
Revenue from sales of stored maize before the use of solar dryer (N)	1,100,000	2,640,000
Revenue from sales of stored maize after the use of solar dryer (N)	2,244,000	4,400,000
Quantity of maize loss before the use of the solar dryer (kg)	600	720
Quantity of maize loss after the use of solar dryer (kg)	120	134

Table 3: **Result of Profitability Analysis of maize in Baba Pupa and Mogan village**

Variable	Farm 1	Farm 2
Total Revenue	2,24,000	4,400,000
Total fixed cost	115, 000	168,000
Total variable cost	087,000	102,650
Total cost	202,000	270,560
Net Profit	2,042,000	4,129,350
Gross profit	2,157,000	4,297,350

DISCUSSION

Respondents' Socioeconomic Characteristics

Majority (82.8%) of the farmers are matured and 17.1% are old and aged (Table 1). This implies that majority of the maize farmers are still agile, experienced and in their productive period. Farming is a noble profession but in different part of Nigeria, it is perceived as profession for the poor, aged and uneducated in the society. This perception may have contributed to discouraging the youth who were highly educated and skilled from the profession as seen in this study.

Majority (88.6%) of the respondents were male as shown in table 1 This indicated that farming activities are still dominated by male farmers. This may be due to the tedious and rigorous nature of farming activities coupled with the prevalent insecurity situation that makes female more vulnerable. Traditionally, farming in Africa and in Nigeria has been regarded as a male activity and this may have contributed to the low number of females that participate in maize farming in the study area. Adjei-Nsiah et al. (2007) suggested that women refrain from maize farming due to fear of produce failure especially during drought, lack of capital and labour and poor access to land.

Less than half (41.9%) of the respondents have primary school education and 28.6% had no formal education while 20.0% had secondary school education. This implies that most of the farmers have low level of education which can impact negatively on their use of modern drying technology. Most (58.1%) of the respondents had over 30years

farming experience. Despite the fact that they have low level of formal education, they are quite experienced in maize farming. Agyare et al. (2014) observed a similar trend among maize farmers in Ashanti and Brong Ahafo Regions of Ghana. Majority (89.5%) of the farmers depended on their personal saving in financing their maize farming activity while 5.7% used cooperative loan from their farmers' association. Half (50.5%) of the farmers had farm size less than 1 hectare while 35.2% had between 2- 5ha. This implies that the accessibility to land usage is poor and it implies majority of them are small scale farmers. Majority (97.1%) of the maize farmers store their maize for over one year and 89.5% use open airdrying method while 10.5% used other methods to dry their maize (Table 1).

Farmers' Profitability Analysis

The profitability analysis carried out in the two farms where solar dryer was compared to traditional open airdrying technique revealed that higher quantity of maize (10,200kg and 20,000kg for farm 1 and 2 respectively) were stored after the use of solar drier in both farms (Table 2). Thus, this showed that solar dryer is more efficient. This further translated to higher yield in both farms with lower post-harvest losses (120kg and 134kg for farm 1 and 2 respectively) and higher profit (₦2,042,000.00 and ₦4,129,350.00 for farm 1 and 2 respectively) as shown in Table 3. The high profit margin and yield is due to the ability of the solar dryer to efficiently dry the maize and maintain its quality. Maintenance of high-quality maize during storage require proper drying and prevent micro-organisms growth and insects (Oyekale et al., 2012). According to Campbell et al., (2004), the current estimates of the cost of grain loss due to insect and microorganism damage of grain stored in developing countries each year ranged from $500 million to $1 billion (Suleiman et al., 2013). However proper drying and storage could help prevent insect and microorganism damage leading to post harvest loss.

Drying methods and maize yield

Togrul and Pehlivan (2004), attributed majority of post-harvest losses and aflatoxin contamination in maize to improper and/or inefficient drying. According to Bewley et al., (2013) seed quality is at greatest risk at high moisture content during storage. This is because storage of maize at high moisture contents (>15%) lead into low germination percentage, dry matter losses (up to 35%) as well as fungal growth and mycotoxin contamination (Afzal et al., 2017). Drying of the maize varieties with modern fabricated solar dryer was the most effective as it took a short time to dry to 10% safe moisture content. Therefore, the earlier a seed can reach safe moisture content for storage the better. Good seed moisture content is essential for seed storage as it increases shelf life and reduces contamination by storage fungi (Bradford et al., 2018). As shown in this

study, modern fabricated solar dryer dried the maize earlier due to maintenance of fairly constant high temperature (up to 45oC) over time leading to reduced moisture content unlike the open-air drying method which has a greater fluctuation of temperature (less than 40oC) over time during wet seasons. According to Tiwari (2016) uneven exposure of grains to constant temperature over time is one of the many disadvantages of using open air-drying technique.

However, effectiveness of the MFSD is dependent on weather but may not necessarily limit its usage during rainy periods, cloudy weather conditions and at night. This finding agrees with the work of (Akowuah, et al., 2018). Open-air drying is usually a difficult maize drying technique during rainy seasons (Buchinger and Weiss, 2002). Akowuah, et al., (2018) equally reported that open air drying can take up to 10 days before safe storage moisture content is achieved.

CONCLUSION

This study was able to ascertain that modern fabricated solar drying techniques of maize reduce moisture content of maize faster and cause considerable reduction in the drying time and with a significant improvement of the maize product quality and income yield compared to other technique.

REFERENCES

Adjei-Nsiah S., Kuyper T. W., Leeuwis C., Abekoe M. K., and Giller K. E. (2007). Evaluating sustainable and profitable cropping sequences with cassava and four legume crops: Effects on soil fertility and maize yields in the Forest / Savannah Transitional Agroecological Zone of Ghana. *Field Crop Research, 103* (2): pp. 87-97.

Afzal, I., Bakhtavar, M. A., Ishfaq, M., Sagheer, M. & Baributsa, D. (2017). Maintaining dryness during storage contributes to higher maize seed quality. *J Stored Prod Res.; 72*: 49–53.

Agyare, A. W., Asare, K. I., Sogbedji, J. & Clottey, A. V. (2014). Challenges to maize fertilization in the forest and transition zones of Ghana. *African Journal of Agricultural Research, 9*(6), pp. 593-602.

Akhtaruzzaman, M., Sohany, M., Basunia, M. A., Hossain, M. K. & Sarker, M. S. H. (2017). Drying and quality features of selected maize varieties dried in commercial processing complexes. *Agricultural Engineering International: CIGR Journal, 19*(3), 148–155.

Akowuah, J.O., Maier, D., Opit, G., McNeill, S., Amstrong, P., Campabadal, C., Ambrose, K. & Obeng-Akrofi, G. (2018). Drying Temperature Effect on Kernel Damage and Viabilityof Maize Dried in a Solar Biomass Hybrid Dryer. *Open Journal of Applied Sciences, 8,*506-517. https://doi.org/10.4236/ojapps.2018.811041

Alshannaq, A. & Yu, J. 2017. Occurrence , Toxicity , and Analysis of Major Mycotoxins in Food. *International Journal of Environmental Research and Public Health. 14*:632-653.

Bewley DJ, Bradford KJ, Hillorst H. & Nonogaki H. (2013). *Seeds physiology of development, germination and dormancy*. New York: Springer.

Bradford, K. J., Dahal, P., Van Asbrouck, J., Kunusoth, K., Bello, P., Thompson, J. & Wu, F. (2018). The dry chain: Reducing postharvest losses and improving food safety in humid climates. Trends in Food Science & Technology, 71, 84-93.

Brewbaker, J. L. (2003). Corn production in the tropics. The Hawaii Experience. College of tropical agriculture and human resources University of Hawaii at Manoa. Available at: http://www.ctahr.hawaii.edu/oc/freepubs/pdf/corn2003.pdf. Accessed on January, 11, 2020 at 11:03 GMT.

Bryden W.L. (2012). Mycotoxin contamination of the feed supply chain: Implications for animal productivity and feed security. *Animal Feed Science and Technology, 173* (2),134-158

Buchinger, J. & Weiss, W. (2002). *Solar Drying*. Austrian Development Cooperation: Institute for Sustainable Technologies.

Campbell, J. F., Arthur, F. H. & Mullen, M. A. (2004). Insect management in food processing facilities. *Advances in Food and Nutrition Research 48*: 239-295.

Corral, L. & Reardon, T. (2001). Rural nonfarm incomes in Nicaragua. *World Development, 29*(3): 427 – 442.

FAO (2017). GIEWS - Global Information and Early Warning System: Country briefs, Nigeria. http://www.fao.org/giews/countrybrief/country.jsp?code=NGA

FAOSTAT (2018). http://www.fao.org/faost at/en/#data. Accessed on January 10, 2020 at 01:09 GMT.

Frisvad J.C., Hubka V., Ezekiel C.N., Hong S.B., Nováková A., Chen A.J., Arzanlou M., Larsen T.O., Mahakarnchanakul W., Samson R.A. & Houbraken J. (2019). Taxonomy of Aspergillus section Flavi and their production of aflatoxins, ochratoxins and other mycotoxins. *Mycology, 93*: 1-63.

Girei, A. A, Saingbe, N. D., Ohen, S. B. & Umar, K. O. (2018). Economics of Small-Scale Maize Production in Toto Local Government Area, Nasarawa State, Nigeria. *Agrosearch, 8* (1): 90 – 104. doi.org/10.4314/agrosh.v18i1.8

Ibitola, O.R., Fasakin, I.J., Popoola, O.O. & Olajide, O.O. (2019). Determinants of Maize Framers' Productivity among Smallholder Farmers in Oyo State, Nigeria. *Greener Journal of Agricultural Sciences, 9*(2), 189-198.

Martinez, M, E., Chapa-Oliver, A. M., Mejía-Teniente, L., Torres-Pacheco, I., Guevara-González, R. G., Vazquez-Cruz, M. A. & Preciado-Ortiz, R. E. (2011). Genetic resistance to drought in maize and its relationship in aflatoxins production. Aflatoxins-Biochemistry and Molecular Biology. *Rijeka: InTech*, 151-161.

Mgbenka, R. N. & Mbah, E. N. (2016). A Review of Smallholder farming in Nigeria: need for Transformation. *International Journal of Agricultural Extension and Rural Development Studies, 3*(2): 43–54.

Oladeebo J. O. (2004). Resource-Use Efficiency of Small and Large Scale Farmer in South Western Nigeria: Implication for Food Security*. International Journal of Food and Agricultural Research, 1*(12), 227-235.

Oyekale, K. O., Daniel, I. O., Ajala, M. O. & Sanni, L. O. (2012). Potential longevity of maize seeds under storage in humid tropical seed stores. *Nature and Science, 10*(8): 114-124.

Suleiman, R. A., Rosentrater, K. A. & Bern, C. J. (2013). Effects of Deterioration Parameters on Storage of Maize. A paper presentation at the 2013 ASABE Annual International Meeting Sponsored by ASABE, Kansas City, Missouri July 21 – 24, 2013. Retrieved from http://lib.dr.iastate.edu/abe_eng_conf/339 on January 11, 2020 at 13:18 GMT.

Tiwari, A. (2016). A Review on Solar Drying of Agricultural Produce. *Journal of Food Processing and Technology, 7:*9, 1-12.

Togrul, I.T. & Pehlivan, D. 2004. Modelling of Thin Layer Drying Kinetics of Some Fruits under Open-Air Sun Drying Process*. Journal of Food Engineering, 65*, 413-425. https://doi.org/10.1016/j.jfoodeng.2004.02.001

Ullah. I., Ali, M. & Farooqi, A. (2010). Chemical and nutritional properties of some maize (Zea mays L.) varieties grown in NWFP, Pakistan. *Pakistan Journal of Nutrition, 9(*11): 1113-1117.

Warburton M.L. & Williams W.P. (2014). Aflatoxin Resistance in Maize. *Advances in Botany*, Article ID 352831, http://dx.doi.org/10.1155/2014/35283

Yaouba, A., Tatsadjieu, N., Jazet, D. P. M. & Mbofung, C. M. (2012). Inhibition of fungal development in maize grains under storage condition by essential oils. *International Journal of Bioscience 2* (6): 41-48.